ORTHOPÆDIC SURGERY.


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LECTURES

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ORTHOPÆDIC SURGERY

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BROOKLYN MEDICAL [illegible]

BY

LOUIS [illegible] M.D., [illegible]

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1868.

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LECTURES

ON

ORTHOPÆDIC SURGERY,

DELIVERED AT THE

BROOKLYN MEDICAL AND [illegible]

BY

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To

JOSEPH PANCOAST, M.D.,

PROFESSOR OF ANATOMY IN JEFFERSON MEDICAL COLLEGE, PHILADELPHIA; AND SURGEON TO THE PENNSYLVANIA HOSPITAL,

THIS BOOK

IS RESPECTFULLY INSCRIBED, AS A TRIBUTE OF HIGH PERSONAL ESTEEM AND SCIENTIFIC APPRECIATION,

By the Author.

PREFACE.

THESE lectures appeared first as successive articles in the *Philadelphia Medical and Surgical Reporter* of 1863 and 1864.

They were hurriedly conceived and written, in a language too not completely at my command; most of the woodcuts imperfectly executed; paper and print of inferior quality. The first edition was a mere reprint from the journal.

Notwithstanding all its disadvantages and defects, it was favorably commented on by the medical press, both at home and abroad; and the ready disposal of the first edition has certainly exceeded my most sanguine expectations.

I have since been enabled to correct errors; to perfect some of my views; to add from cumulative experience; to improve the literary structure; and now submit the second edition of the work to the profession.

Among the new subjects I have included joint diseases, to which I had barely alluded in the first edition. In doing so, I have been guided by the advice of professional friends, and by the conviction that the subject properly belongs to the orthopædic domain, being one of the most prolific sources of deformities.

It will be observed that most illustrations have been replaced by new engravings, and that their number has been largely increased.

In conclusion, I feel it an agreeable duty to express my acknowledgments to Mr. Ford, Surgical Instrument-maker, 85 Fulton Street, New York, for the efficient assistance rendered to me in the improvement and perfection of orthopædic apparatus.

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ORTHOPÆDIC SURGERY.

CHAPTER I.

Introductory and historical remarks.—Prejudices of the American Profession against specialties.—Argumentation in their favor.—Special pursuit the true base of scientific advancement.—Definition of orthopædia. —General causes and distribution of deformities.

GENTLEMEN:—Since the establishment of the Brooklyn Medical and Surgical Institute, quite a large number of patients afflicted with deformities have been received and attended to. The clinical material that has thus been placed at our disposal has been both considerable and instructive.

Actuated by the desire to render this institution subservient to the advancement of medical science and art, its enlightened Board of Trustees has decided to open its pathological resources to the profession at large, and to institute such lectures as may best subserve their liberal intention.

Having been appointed one of the lecturers, I have chosen the subject of orthopædic surgery—a comparatively new one on this continent, but nevertheless one of the most important and interesting branches of the healing art.

Heretofore, this subject has by no means received in this country that attention it so eminently deserves, and the professors of surgery have held out to students but indifferent opportunities to become familiar with it, either theoretically or practically. While, therefore, the profession felt scarcely competent to take the responsibility in the treatment of distortions, and rather timorous to engage in it at all, the patients thus afflicted were either left without relief, or had to seek it among empirics, pretenders, and mere mechanics.

The propriety of preferring the subject of orthopædy to any other, for the purpose assigned, can therefore not be questioned;

and I confidently hope that some good results may accrue from our efforts, both in a professional and public point of view.

I, however, do not mean to say that this is the first attempt to render orthopædic surgery a common property of the profession. In a fragmentary form, clinical lectures have been delivered from time to time, by Dr. Detmold, of New York; and at the present time my esteemed friend, Prof. Lewis A. Sayre, is engaged in a complete course at the Bellevue Hospital Medical College of New York, which cannot fail to be highly instructive, and most certainly will enhance the practical efficiency of medical tuition.

My lectures will not be entirely theoretical. The museum of this public Institution is, in point of orthopædy, tolerably complete, and it will enable me to illustrate almost all the distortions by plaster casts and diagrams taken from life. I shall also avail myself of all clinical opportunities that may in the course of our lectures present themselves, to exemplify diagnosis and to test the rationale of the adopted therapeutical principles and maxims. The respect for your valuable time will protect you against worthless speculations. I purpose to be brief, and, to the best of my humble ability, practical.

The knowledge of deformities is as ancient as deformities themselves. In the sixty-second chapter of the works of Hippocrates, "On the Articulation," we find a comprehensive sketch of club-foot, its attendant symptoms, and fragmentary but correct views of its treatment. Very little was done to advance the knowledge on that subject for many centuries. We meet but scattered and imperfect ideas by Ambrose Paré, Severinus, Arcæus, Fabricius ab Aquapendente, and others.

Professor Andry, of Paris, was the first who collected the scattered information on orthopædy, put it in a tangible form, and introduced the collective title* which this branch of the healing art now bears. He attempted also to ferret out the common causes of deformities, and to establish general indications and maxims for their effective treatment. But he certainly transgressed the boundaries of the orthopædic domain by including the deficiencies of the eye, ear, hair, nails, etc., thus mixing up heterogeneous subjects which had no pathological or thera-

* L'orthopædie, ou l'art de prévenir et de corriger dans les enfants les déformités du corps. Paris, 1741.

peutical affinities to each other. Andreas Venel, of Switzerland, subsequently (1780) corrected the errors of Andry, and established the legitimate boundaries. Venel was the first who created an institution for the exclusive treatment of distortions of the human frame. From that time orthopædy began to enlist the interest and ardor of eminent practitioners, and their efforts gave it a more scientific character.

In connection with the early advancement of orthopædy, it is but just to mention with distinction the names of Brücker, Camper, Wenzel, Paletta, Scarpa, Sömmering, Delpech, Heine, and others. But the greatest, and certainly most important impetus for its scientific culture, orthopædy derived from the introduction of subcutaneous myotomy and tenotomy, by Stromeyer. That operation at once rendered a large proportion of deformities amenable to treatment, which before had been set down as beyond the reach of surgical means. Other improvements have since followed in rapid succession.

The discovery of anæsthetics has largely aided in advancing orthopædic science, and we have now arrived at a period in which it may be safely placed alongside with other branches of scientific medicine, and certainly without detriment to their dignity and perfection.

Orthopædic surgery has for many years been a favorite subject in Germany, and her most distinguished surgeons have assiduously joined in its culture. Besides Stromeyer, Dieffenbach, Lorinser, B. Langenbeck, Robert, Berend, and other prominent men, have productively labored for it. In France, Jules Guérin, Major, Marjolin, Malgaigne, and Louvrier have materially aided in diffusing and improving orthopædic practice.

Dr. Little has been its chief apostle and promoter in England. Himself a sufferer from congenital club-foot, he went to Germany, and obtained relief at the masterly hands of Stromeyer and Dieffenbach. With grateful enthusiasm for the new method of treatment, and determined to extend its benefits to his fellow-sufferers, he zealously entered upon the enterprise of establishing an orthopædic hospital, in which it is but just to say he was most generously aided by his countrymen. Nobody can pass Bloomsbury Square, in London, see the noble institution, the Royal Orthopædic Hospital, and contemplate its reports of the

thousands of patients that have received at its hands aid and comfort, without thinking of the beneficence and great scientific merits of its founder and chief laborer.

The inestimable boon which that charity has bestowed upon the poor and helpless may best be realized in the 12,000 patients that were attended and relieved in one decennium (1841 to 1851). And the numerous literary publications that have from time to time emanated from the medical officers of that institution, are sufficient evidence of their scientific working.

As soon as the practical requirements of orthopædic charities had thus been demonstrated, they became established in most of the great cities of the United Kingdom; and I believe it to be no exaggeration in stating that at present 12,000 patients, afflicted with deformities, receive in the course of one year gratuitous attendance in Great Britain.

In the United States the historical records of orthopædy are not as favorable. Its advancement has met with serious obstacles on the part of the profession; and all attempts at cultivating it as a specialty have, as specialties in general, been frowned down as the pretences of quackery.

As a mere subordinate branch of surgical art, orthopædy could never develop itself to that degree of perfection it has acquired elsewhere by special devotion and culture. In Europe, public and private institutions for the exclusive treatment of deformities abound, thrive, and are appreciated by the profession, not on account of their pretences, but the actual benefit they afford to multitudes of patients. Besides the discipline of the patients, so indispensable for methodical and mechanical treatment, they are provided with all the technical facilities and requirements of an efficacious management. They procure competent nurses and medical attendance, which in a private dwelling are scarcely to be obtained with the same degree of proficiency.

The objections of the profession to specialties are based partly on wrong premises, partly on mere notions. The country abounds with quacks and pretenders, who victimize and fleece the community at a fearful rate. There is no law to arrest their illegitimate invasion of the professional domain. They presume with impunity on the honorably acquired character of the profession, and unscrupulously override all boundaries of decency

and honesty. They gather around themselves sufferers by the hundred, and are inexhaustible in their promises and schemes to delude the ignorant and credulous portion of the community. What medical art is impotent to achieve, the quacks arrogantly claim as their divine secret. Divination is their claimed inheritance, from which the profession is obviously excluded, and Newton is the great redeemer of afflicted humanity. The fraudulent practices of impostors prove certainly nothing against the scientific and practical pursuit of specialties.

It surely does not follow that specialties would undergo the same degeneration from their honest course, and culminate in pretentious quackery! In Europe this has not been the case; and the few specialties which have been fostered in our midst have certainly given no just cause for apprehensions of this kind.

On the other hand, competent and unbiassed judges cannot hesitate to admit that the rapid advancement of medical science and art during the present century is in a great measure owing to the division of labor. Without the special investigation of Laennec, Skoda, and Traube, our knowledge of the diseases of the lungs and heart would be in its infancy. Cramer has almost entirely created anew the pathology of the hearing apparatus. Von Graefe is assiduously at work to reconstruct ophthalmology on a rational foundation, and for that Augean labor he certainly deserves commendation and support. And must I remind you of the ingenious improvements our distinguished countryman, Dr. Marion Sims, has wrought in one of the most fearful defects women are liable to? Read the history of the operation for vesico-vaginal fistula, and you will find that his whole time has been absorbed in perfecting its technicalities. His labors and achievements have been liberally recognized by the highest scientific tribunals of Europe, which must fill the heart of every American with pride and emulation.

The same beneficial influence of specialty I could prove in almost every department of medical science, to meet objections so utterly groundless.

No competent man advocates the establishment of specialties at the expense of medical science, and independent thereof. On the contrary, they should emanate from medical science; receive their chief maintenance from it, and return

its results to the same source from whence they originated. Not as the ancient Egyptians pursued specialties, *per se*, and disconnected from each other. Such a system would be prejudicial to scientific advancement, unproductive of practical results, and terminate eventually in the crudest empiricism. This preposterous system has been finally adjudicated by history, and has certainly no earthly chance of being resuscitated.

The steady progress of medical science, and its already acquired magnitude, will inevitably settle the pending question. Practitioners will have to choose between general superficiality and special efficiency.

With these premises, I yet hope to see the day that in this country orthopædic hospitals and institutions will spring up with the coöperative support of the profession, where the afflicted and distorted will find ready and efficient aid.

After this opportune digression, I beg to resume the subject-matter. If I am correctly informed, it was Dr. Detmold who introduced tenotomy into the United States. Having enjoyed the inestimable privilege of Stromeyer's personal tuition, he commenced his orthopædic career with the enthusiasm and energy of a brilliant intellect. Great must have been the inducement to that talented surgeon to cultivate as a specialty the large, undisputed, and heretofore unexplored field; and we understand that he zealously labored to render his knowledge alike useful to the deformed and to the profession. Yet the professional notions he encountered must have been too strong for his perseverance, and thus he had to content himself with the ordinary professional rank.

No American surgeon realized the importance of orthopædic surgery more fully, and felt more earnest solicitude for its propagation, than our venerable Nestor the late Valentine Mott. In his interesting "Travels in Europe and the East," he expresses himself in the highest terms of appreciation of "this illustrious era of the healing art." Indeed, though at the eve of an eventful and useful life, and distinguished by all the honors of a grateful country, his enthusiasm was so deeply aroused as to express his determination to lend his influential aid in the erection of "an American orthopædic institution" in the city of New York, that the principles "of that inestimable science might be

diffused far and wide." But even Dr. Mott yielded to professional prejudice an enterprise which enthusiasm and "gratitude to Guérin, to his friends and country," had conceived, and which could not have failed in contributing greatly to the relief of the poor and helpless, and the promotion of professional interest; an enterprise which he himself estimated as the crowning act of his long and fruitful life.

All individual efforts of other practitioners have since signally failed in this direction. Professional pride did not allow them to call upon the public for support, and professional encouragement and favor were withheld. Hence orthopædic surgery has as yet acquired no status, and is certainly not the common property of the American profession.

The term "orthopædia," first used by Andry, has been generally accepted for that subdivision of the healing art which considers the deformities of the human frame, their prevention, causes, and treatment. The etymology of the term is derived from ὀρθός, straight, παιδεύω, to educate.

Orthopædy does not include, however, all deformities, especially those of a mere transient nature, as, for instance, the deformities connected with fractures and dislocations. The malposition of the eyeball (strabismus) has been properly transferred to ophthalmology. Defects and distortions of the integuments, and their relief, form another subdivision under the appellation of plastic surgery, and so on. Thus orthopædy is strictly limited to the more permanent and not rarely congenital deformities of the skeleton and the locomotive apparatus. The various attempts at arranging the orthopædic objects in systematic order have proven as many failures. There is, indeed, no organic cohesion between the objects of this specialty; the similarity of treatment is the only connecting link, and of course that is not available as a systematic distinction.*

The grouping of the subject is therefore as arbitrary as the composition of the orthopædic discipline.

Most deformities originate spontaneously either in morbid changes and actions of the nervous system, or vitiated nutrition (rachitis).

With but few exceptions, almost all deformities of the body

* New York, 1842.

are of a *consecutive* character. The bones merely act as passive agents in following the traction of the muscles. The latter, in their turn, are subservient to the nervous system, reflecting all the morbid changes that may take place in that sphere. If, however, a deformity has become firmly established, and has lasted for some time, both bones and muscles undergo more or less permanent changes in form and texture, and the difficulty may ultimately become irremediable. The ligaments are, by virtue of their structure and function, not as often implicated in deformities as bones and muscles. Sometimes they are compromised by the formation of sclerotic tissue at the articulations; in paralysis they seem to become relaxed, and therefore facilitate an undue mobility of their respective joints.* But a contraction of ligaments is a physiological impossiblity. Their dimension is regulated by elasticity. They may lose that elasticity by structural changes; they may become elongated by loss of elastic fibres and excess of fat. It can, however, not be conceived how they can become shortened by any other process than sclerosis, and this presupposes local inflammation.

A most fertile source of deformities are the diseases of joints. Not so much from displacements, anchylosis, or cicatrices, as from permanent contraction of muscles. There is scarcely an articular affection that is not more or less complicated with muscular contractions, and consequently with deformity, mostly of permanent duration. The true pathological nature of these muscular contractions has only of late been recognized, and its indirect connection with the morbid process in the joint traced to *the reflex action of the spinal cord.*

Inasmuch as I have been prevailed upon to include joint-disease in this discourse, I refrain from entering more deeply upon this subject at the present occasion.

In motor paralysis I have frequently met with contractions of single muscles, and entire groups. To all appearance, both the paralysis and the contractions emanate from the same pathological source, though differing, perhaps, in the time of their commencement. Often paralysis and contraction set in contemporaneously. Sometimes the former precedes the latter by

* I have met with patients who could at a minute's warning dislocate some of their joints.

months and years, or the subsequently contracted muscles may have been previously paralyzed.

Pure reflex contraction occurs only in *healthy muscular structure.* The coincidence of paralysis and contraction is a very interesting phenomenon, and its proximate cause has greatly puzzled pathologists. The difficulties are, however, more apparent than real. Physiology discloses the means by which we may penetrate the mystery. Remember that all muscles subservient to our will are endowed with two different sets of nervous fibres: the one descending from the brain, conveying the impulses of volition; the other originating in the ganglionic structure of the spinal cord. The excito-motor innervation of the latter is, by far, the more powerful. Thus it happens that in spinal palsy the will may still prompt a muscle to a feeble action; and in cerebral paralysis, contractions of muscles may take place by centrifugal or centripetal excitation.

Muscles that have lost all their excitability, and upon which Faradization can produce no effect, are totally incapable of contraction, either transient or permanent.

I have observed a goodly number of cases that fully bear out the proffered explanation, but consider it hardly necessary to narrate them at this juncture.

Whatever may be the cause of muscular contractions, whether they be of shorter or longer duration, they are scarcely susceptible to any other remedy than the knife. This seems rather strange, that symptoms should perpetuate their existence beyond the exciting cause; yet the numerous facts in proof are so indisputable as to allow of no doubt.

Whether the contraction be perpetuated by nutritive deterioration of the muscular structure, preventing relaxations, as, for instance, by sclerotic tissue, changes not as yet sufficiently investigated or determined, is a question too subtle for an easy solution. At any rate, the structural explanation would fail to satisfy in recent cases, unless nutrition is, indeed, more rapid in the contracted muscular structure than I have reason to presume.

The idea is therefore suggested, that the interested nerves themselves participate materially in the perverted nutrition, or a habit of action is set up determining the duration of the contraction, as is certainly the case in clonic spasm.

Respecting congenital deformities from contracted muscles, I can admit no other pathological laws than in acquired ones. The hypothesis advanced by Cruveilhier, that the position of the fœtus in utero had something to do with the former, seems to me untenable, in as far as the muscles themselves are concerned.

Paralysis may give rise, in different ways, to deformities: First, the joints lose their firmness and support, by the relaxation of their muscles and ligaments, bending in the direction to which their surfaces may incline. This state implies complete motor paralysis, and constitutes *passive deformity*. Secondly, but one muscular group may be paralyzed, and its antagonists retain more or less power, and draw the joint to their side.

That paralysis of motion and sensation, or of either, greatly interferes with nutrition of the member is self-evident. It is, however, observed, that diminution of maintenance is by far more marked in palsy emanating from the spinal cord than from the brain. The difference is purely anatomical, on account of the spinal nerves receiving a greater complement of fibres from the great sympathetic system governing the organic functions.

In proportion to the sluggish nutrition in paralyzed parts of the body, stands the repair. All structural disturbances manifest a degree of venous hyperæmia, and a great tendency to sloughing. *A true active inflammation scarcely ever takes place in paralyzed extremities*, which is but an analogon of the fact that *inflammation is never observed in the lower species of animals with an imperfect nervous system.*

In the catalogue of general causes productive of deformities, to the *disturbance of the centre of gravity* of the body has been assigned a prominent place.

To the diligent and instructive experiments of Prof. Weber, we owe the accurate knowledge of the mechanical laws ingrafted upon the construction of the human frame and its locomotion.

According to that author, the centre of gravity locates at the centre of the lumbo-sacral articulation, for the perpendicular will always pass through it in whatever position a man may be balanced upon a board, resting, and itself balancing on a prism.

Anything tending to increase or diminish the weight of either side of the body, will inevitably throw it out of its perpendicular. Thus, the loss of one of the extremities will disturb the centre of

gravity. The enlargement of one of the internal organs, more especially the liver; the distention of one of the pleural sacs with fluid, or a tumor of some size on one side of the mesian line, would have the same physical effect. Inasmuch as the like causes are of a more transitory existence, and the body is in a condition to allow change of posture, their influence upon the frame will be a temporary distortion only, if, indeed, it could be called so, and *vice versâ*. I know patients who, for half a century, have suffered from declivity of the pelvis, on account of shortness and malposition of one of the lower extremities, and their spine is consequently thrown out of the perpendicular. If they assume the erect posture or gait, their vertebral column presents the lateral sigmoid form. Yet if they sit down, and their pelvis rests equally upon the seat, the spine becomes perfectly straight. You perceive, therefore, that the change of position counterbalances physical defects, and prevents permanent distortions of the skeleton.

From these facts, and numerous others that might be adduced, it follows conclusively that the simple mechanical derangement of the centre of gravity can alone effect no permanent consecutive deformities, and that other pathological elements have to come into play.

Some orthopædic surgeons, and more especially the late Dr. Buehring, of Berlin, deduce the preëxisting cause adverted to from two sources: 1st. From the *natural* deviation of the spine from its perpendicular toward the right of the mesian line; 2d. From *constitutional debility and inefficient nutrition* at certain periods of life.

With reference to the former, I have to say that the assertion is correct in point of fact. Numerous measurements of the spinal column in healthy and otherwise well-formed persons with the plummet-line, instituted by Buehring, myself, and others, have clearly demonstrated such a deviation, however trifling. And the fact that by far the largest proportion of lateral curvatures of the spine occur towards the right, obviously strengthens the position of Buehring.

Whether that deviation is the result of the exceptional exercise of the right arm, or whether the unequal weight upon the spine by asymmetry of the internal organs, increased by the diag-

onally acting heart, the spine being thus hammered out, as Buehring presumes, cannot be determined by the present inadequate state of our knowledge.

In reference to the second cause, I sincerely believe it to be the most prominent in the establishment of lateral curvature. In its behalf speaks clinical observation. Five-sixths of all deformities of this class occur in girls, and at the time of their change in life, when their system is somewhat deranged; when the uterine function has not as yet become well regulated and established; when the blood is impoverished, or even hydræmic; and when, consequently, their nutrition is insufficient. In the rugged and robust daughters of the poorer classes, lateral curvature is but rarely seen. Among the physically neglected young ladies, that deformity is widely diffused. I beg not to be understood that other causes are not productive of the same effect; yet this we may be sure of, that debility of the constitution is the most general one.

Idiopathic deformities, that is to say, deformities of a strictly local character, are few in number and rare in occurrence. The most prominent are those from burns in the neighborhood of joints.

Next I have to mention the inflammation of muscles, with subsequent *progressive* alteration of their texture, or, which has been termed by Duchenne and Remak, *progressive paralysis.* This disease implies two pathological elements: *change of structure*, and *loss of tonicity*. The transversely striated muscular fibres gradually disappear, and sclerotic tissue is substituted in their place, or fatty degeneration ensues. In the one, shortening of the muscular belly, and deformity, is the inevitable result. In the other, the muscle is, to all intents and purposes, extinct. Fortunately, the disease is altogether rare, but few legitimate cases having been recorded. I have never had an opportunity of personally observing one. It has been maintained that the disease may gradually invade the entire muscular system, and successively disqualify it for its physiological office, and that the uninterrupted galvanic current is the sovereign remedy. Of this I have no personal experience, and must refer you to Duchenne and Remak's respective works.

The preceding remarks on the causes of deformities have been

purposely of a general nature. I did not intend, for the sake of completeness, to put forth things which are fully known to every practitioner, nor to enter upon causes which we have to touch upon again under the special heads of our subject.

CHAPTER II.

DEFORMITIES OF THE FEET.

Anatomico-physiological sketch.—Frequency of pedal distortion, and its causes in general.—Diagnosis and terminology.

GENTLEMEN :—The anatomical structure of the human foot is a most admirable and perfect piece of mechanism. Composed of twenty-six bones, fastened to, and articulating with each other, the foot combines a high degree of firmness and elasticity. It is, therefore, well adapted as a foundation for the body in the erect posture. It assumes for locomotion the manifold positions required, and preserves, under all physiological necessities, strength and reliance. To achieve so complicated an object with the greatest economy of space, nature has given to the foot a double arch : one between the heel and the ball of the great toe—*the longitudinal arch ;* the other between the two margins of the foot supported by the heel, the capitulum of the first and the tuberosity of the fifth metatarsal bone—*the transverse arch.* The two arches form a niche at the sole of the foot, and endow it with great strength. The plantar aponeurosis adds materially to the capacity of the longitudinal arch for bearing the weight of the body ; and its strength prevents, under ordinary circumstances, any breaking down. The transverse arch is not as strongly supported.

The short transverse ligaments permit expansion to such a degree as to bring the fibular margin of the foot down to the floor, as can be readily demonstrated by an experiment. By placing your foot in water, and afterward standing with the entire weight of the body upon the floor, the external margin is imprinted to its full extent, and so firmly, that a piece of paper cannot be removed from below that side, whilst the internal margin leaves no trace behind. For ordinary locomotion the toes seem to be dispensable appendices. But if the foot is fully extended, the body being raised upon the capitula of the meta-

tarsal bones, the toes come into play by enlarging the base. Pliny's remark, "digiti gressu solum apprehendunt," is therefore most appropriate.

The tibio-tarsal articulation is so constructed as to permit the approximation of the foot to the leg (flexion), to an angle of 78° 2″ (Weber), and the extension may be carried to an angle of 120°. Besides flexion and extension, the foot is capable of performing other motions, in which the ankle-joint takes, however, a very limited part. In the rotatory movements on the longitudinal axis, the astragalus slides a little forward. Adduction is chiefly carried out by the astragalus and the scaphoid; abduction, by the calcaneus and cuboid bones.

In greater rotations of the foot, the calcaneo-astragaloid articulation comes into operation.

The muscles affecting ordinary flexion are the *tibialis anticus* and the *peroneus tertius;* in the higher degrees, the *extensor digitorum longus* and *pollicis longus* materially aid.

A similar arrangement exists in the extension of the foot, the ordinary extensors being the muscles that terminate in the Achillis tendon, *gastrocnemius*, *soleus*, and *plantaris;* whereas the higher grade of extension is aided by the *tibialis posticus*, *peroneus longus* and *brevis*, *flexor digitorum longus*, and *pollicis longus* muscles.

Adduction of the foot is exclusively effected by the *two tibiales* muscles; while abduction is carried out by the *three peronei* muscles *conjointly*.

As to the nerves supplying the different groups of muscles, Bonnet's experiments have disclosed that the peroneus nerve furnishes the motor fibres to the extensors of the toes and the peronei muscles; while the tibial nerve supplies the rest. That his observations are correct, I have reason to infer from clinical facts which have come under my observation, and which I shall adduce in their proper places.

From the anatomical structure and the mechanical importance of the foot, it should be inferred that it is frequently the subject of deformity and malposition. And this is actually the case. Nay, more, they are not only the most numerous, but likewise of a stereotyped nature.

A considerable portion of pedal deformities is *congenital;* the

larger number, however, is acquired. As to their remote causes, we can often trace them to troubles of the nervous system. They but rarely consist in defective development or absence of some of the bones of the foot (Bilroth*).

In my practice, I have seen but three cases in which anatomical defects gave rise to deformities, and one of them was coexistent with hare-lip and congenital hydrocephalus. A third malformation was aggravated by misplacement. One foot directly articulated with the femur; there was no patella. At the other extremity, the knee-joint was normal; the tibia but fragmentary; fibula absent; and the defective foot occupied a reversed position, the heel being in front. In every other respect the little boy, then eight years of age, was most perfectly formed, and endowed with a brilliant intellect.

Bilroth's case constituted pes varus of the highest grade of the right foot, and pes varo-calcaneus of the left. The patient died from pneumonia, fourteen days after birth, when it was ascertained that the deformity of the right foot had been caused by the *absence of the entire tibia*, whereas the left presented the ordinary condition. In the right extremity the muscles of the inner side of the thigh inserted partly into the capsule of the knee-joint, partly into the aponeurosis of the leg, causing thereby permanent flexion of the knee. The patella presented an oblong form; there was no ligamentum patellæ. The capsule of the knee-joint was normal; the ligamentum laterale internum being absent. The fibula partook, with a dorsal surface, in the formation of the knee-joint, and was so loosely connected as to allow dislocation. In place of the cruciated ligaments there were but parallel folds of the synovial membranes.

The triceps muscle of the calf, tibialis posticus, and flexor digitorum communis longus considerably shortened. The flexor pollicis longus and tibialis anticus were entirely wanting. The tibialis posticus and flexor digitorum com. long. originated from the aponeurosis cruris, the rest in part from either the latter or the fibula, which was of ordinary size. Nerves and vessels normal in number and course.

The other case was observed in a female and well-grown child, nine months old. The left foot presented *defect of fourth toe*,

* Archiv der Klinischen Chirurgie, vol. i., heft 1, Berlin, 1860.

fifth metatarsal bone, and *internal malleolus*, and had the malposition of valgus, the triceps muscle of the leg and peroneus longus being contracted.

These defects must indeed be rare, when the very complete works on malformation of Cruveilhier, von Ammon, and Vrolik are entirely silent on the subject. The only allusion I found in Robert is the case of Duval, concerning the defect of the fibula.*

The inflammation of the tibio-tarsal and intertarsal articulations occasion, by reflex contraction of muscles, malposition of the foot. Of a considerable fraction, we know no causes whatever.

For the more stereotyped deformity of the foot, the generic term "*talipes*" has been introduced and applied to all distortions from the normal position, with or without partial displacement of the articular surfaces of the tarsal bones.

According to certain malpositions of the foot, the varieties of talipes have received different appellations. If the internal margin of the foot is raised, and the toes inverted, it is called *club-foot, talipes varus;* if the plantar arch is broken down, the external margin of the foot elevated, and the toes everted, we have *talipes valgus*, or *flat-foot;* in *talipes equinus* the heel is abnormally raised from the ground, and the foot placed in permanent extension; or *talipes calcaneus*, when the foot occupies the reverse position of the latter. Combinations between the previous simple forms of talipes are respectively termed equino-varus; varo-equinus; equino-valgus; calcaneo-valgus, etc.

The exact diagnostic discrimination of the various complicated forms is a matter of great importance, exercising a material influence.

I.

TALIPES EQUINUS.

Symptoms.—Causes.—Prognosis.

The semiotic character of talipes equinus is briefly as follows: The foot is more or less completely extended, and, in exceptional cases, may be placed in direct continuance with the leg. The

* Des Vites Congénitaux de Conformation des Articulations, page 34.

remaining mobility is in the reverse ratio to the degree of extension; that is to say, it diminishes with the increase of the latter. The foot rests upon the ball, and chiefly upon the ball of the large toe, Fig. 1. The plantar arch is materially increased,

FIG. 1.

FIG. 2.*

and the toes, more especially the large one, are drawn back. The Achillis tendon is found to be extremely tense, and is rendered still more so by attempting to flex the foot. The plantar aponeurosis is likewise shortened, most likely by contraction of the plantar muscles. The extensor digitorum communis and pollicis longus are but rarely contracted; and if we find them so, it is most probably in consequence of the habitual action of those muscles to prevent the toes from interfering.

That part which comes in contact with the floor is invariably covered with a thick and massive callosity. The entire extremity is greatly attenuated and arrested in its growth and development; the more so, the longer the distortion has existed (Fig. 2). In addition, we observe sluggish capillary circulation and diminished temperature of the member, which manifest their

* Fig. 1. The cast of limb of a young gentleman who became paralyzed when a child. The affected limb is three inches shorter than the other.

effects more particularly in cold weather, when the limb becomes bluish red, mottled, and loses all its caloric.

The foot is of course shorter than its fellow, partly from arrested development, partly on account of the increased arch; and it is indeed very rare that it acquires its proper size. In front of the tibio-tarsal articulation we clearly notice the trochlea of the astragalus, the superior surface of which lies almost in the same plane with the tibia. The malleoli are not sufficiently developed, and the diameter of the articular axis is generally diminished by one-eighth of an inch and more.

Though the grastrocnemius and soleus muscles are chiefly involved in talipes equinus, I have met with instances in which the entire group of extensor muscles participated in the deformity. This is particularly the case in serious lesions of the spinal cord; and once I observed it as the sequel of a fracture of the lumbar portion of the spine. Whether the tibialis posticus, the two peronei, and the flexor muscles of the toes are involved, is by no means so easy to determine, because the tendons of those muscles are bound down to the grooves of the malleoli by serous slides, and the aponeurosis of the leg is particularly thick and strong about the ankle-joint. Sometimes the tendons have left their respective grooves, dislocated as it were, and moved to the outside of the malleoli from the continuous stretch, and this may facilitate the diagnosis; but at others, we do not become aware of the difficulty until the Achillis tendon has been divided without producing the desired effect.

As a general thing, the contracted muscles have lost all susceptibility of being acted on by the galvanic current, yet their powerful extension gives rise to unbearable pain. This fact seems to demonstrate that the muscular structure is in a state of contraction to the extent of its capacity, or the substituted tissue is devoid of all contractile power. It is certain that innervation has not entirely been lost while pain can be provoked by extension.

After the division of the tendons, many months may elapse before the galvanic current makes any impression, and, in some instances, the contractility of the muscles never becomes reestablished.

As might be expected in talipes equinus of long standing, the bones themselves participitate in the deformity. Their mal-

formation exercises, of course, a material influence upon the prognosis.

I have observed two or three cases of talipes equinus in which most of the symptoms just enumerated were wanting, and in fact all that characterized the trouble was the extended position of the foot, and the retraction of the tendo-Achillis. Moreover, the extremity was well maintained, of ordinary temperature and color. The prevailing cause proved to be *arrest of growth* of the extremity from unknown causes, and the patients had extended the foot in order to elongate the limb, and to walk with greater facility. In course of time they had lost all volition in reference to the extensor muscles, which became fairly contracted, and the malposition belonged undoubtedly to talipes equinus. It would be unwise to interfere in those cases. In all respects, the position of the foot is serviceable, and certainly preferable to a high boot.

Talipes equinus is but rarely congenital; most usually it is *acquired*, and *depends on affections of the spinal cord or its investments, or of both.* I have observed talipes equinus as the exceptional consequence of posterior curvature of the spinal column, of fracture of the first and second lumbar vertebræ, and once of a wound in the back. The injury was inflicted near the tenth dorsal vertebra, by a strong-bladed knife. From the fact that the knife stuck fast, and was removed with difficulty, it seems to be justifiable to infer that the blade had entered the bone. The wound closed without delay. A few days after the accident, the patient, a strong mechanic of about thirty-five years, was attacked with what seemed to be severe cramps in his left calf, which eventually terminated in tonic contraction of the entire group of extensors of the foot, and in a high degree of talipes equinus.

It is rather interesting to observe the process by which talipes equinus is superadded to already existing paraplegia. I remember a few cases in which the paralysis of the lower extremities had existed for some years without any change, when suddenly, and without apparent cause, the patient was attacked with severe rigor, lasting for some hours. During the same time the patient noticed painless contractions of the extensor muscles of the feet, which became permanent, eventuating in extreme talipes equinus.

In other cases of paraplegia, the commencement of talipes equinus initiated a partial return of sensation and motor power, as it likewise happened in the case of fracture of the spine.

In regard to the *prognosis* of talipes equinus, we have to consider the deformity *per se*, and the nature of its cause. The former is comparatively trifling unless the tarsal bones are so much malformed as to prevent or aggravate their readjustment, which, however, is not so often the case.

As a general thing, you have to deal only with the contracted muscles, and division is the sovereign remedy, But if the case has existed from infancy, the bones have in form accommodated themselves to their abnormal position, the tibio-tarsal articulation is crippled, then the prognosis is rendered doubtful, and the case may be even irremediable.

In order to accomplish a cure, both malposition and malformation of the tarsal bones have to be corrected, which, at best, is a slow process, and, as already stated, may not be accomplishable at all.

The second point that enters upon our prognostic consideration is, the proximate cause of the trouble. We may have succeeded in removing the deformity by appropriate measures, and in keeping the foot by mechanical appliances in proper position. This is but palliative relief, and is not a cure.

In order to achieve success, you have to reëstablish proper innervation of the afflicted extremity, promote its nutrition and development, and give tone to the muscles. Such a result we are mostly debarred from accomplishing, however assiduously and perseveringly we may advance with our auxiliaries, and therefore we should be guarded in our prognosis, and promise no more than we are capable of realizing. In children, however, the prognosis of talipes equinus is more favorable, for it has been observed that with the relief of the distortion, the nutrition, growth, and development became improved. It must not be forgotten, however, that the extremity very rarely keeps pace with its fellow.

II.

TALIPES VARUS.

Symptoms.—Pathological Anatomy.—Causes.—Prognosis.

Simple club-foot is rare. That deformity which is generally designated as club-foot is a combination of varus and equinus.

Varo-equinus is a frequent deformity. There is hardly a community, however small, among which could not be found one or more cases. Most usually it is of *congenital origin*, and very seldom acquired. If so, club-foot is superadded to preëxisting talipes equinus, and paralysis of the peronei muscles.*

The anatomical derangement in club-foot is somewhat complicated. I shall discuss it at some length, in order to render it more comprehensible.

In the specimen before you, Fig. 3, representing the highest

FIG. 3.

* On two occasions I had the mishap to divide the nervus peronæus with the tendon of the biceps muscle of the femur. Paralysis of the m. m. peronæi and extensores digitorum ensued, temporarily causing talipes varus.

grade of club-foot, and taken in plaster-of-Paris, from a farming laborer twenty-seven years of age, you notice most of the general symptoms enumerated under the head of equinus, viz., *attenuation* of the extremity, *arrest of growth* and *development.*

And what you cannot perceive in this plaster cast, I may be allowed to add: *loss of temperature, mottled appearance*, etc. The difference in the length of this extremity and that of its fellow amounted to *three inches* at the end of a three years' and at last successful treatment. In placing the cast into the same position in which the patient used his deformed member, you can realize the full extent of the distortion.

You notice thus that the foot is longitudinally so turned, that its external margin stands on the floor, whereas the internal margin is uppermost. The foot touches the ground a little anteriorly from the external malleolus, where, from pressure, *a large callosity* has formed. Again, you observe that the back of the foot has a *forward*, and the plantar surface a *backward* direction, which, of course, implies *inversion of the toes.*

In comparing this with another cast, derived from valgus, you perceive the *directly opposite condition.* In varus, the dorsum has been *elevated* and rendered more *convex;* in the other, the dorsum is almost *flat.* In the former, the plantar arch is *greatly increased;* in that of valgus it is *entirely broken down*, so that no arch at all remains, and the tarsus comes in contact with the floor. Furthermore, here is an *inflexion* or *infraction*, noticeable at the internal margin, which has the effect of *approximating heel and large toe;* in valgus, the infraction comes from the external margin, and, in the highest grade of this deformity, tends *to bring the heel nearer to the small toe.* In my case, the cuboid, the anterior portion of the calcaneus, and the tuberosity of the fifth metatarsal bone, protrude; in the other, as stated, it is chiefly the scaphoid bone.

I now propose to investigate the morbid anatomy of club-foot, the result of which has practical bearing upon its treatment. The conflicting statements of authors on the pathologico anatomical condition of club-feet, derived from autopsy, seem to be strange to the inexperienced; not so, however, to those who have given some attention to the subject. There is a great *variety* in club-feet, which necessarily must present somewhat *dif-*

ferent anatomical aspects. The greatest difference accrues, however, from the *duration* of the deformity.

In most infantile club-feet, the difficulty merely seems to consist in contracted muscles; and as soon as that has been overcome, the bones may be reduced to their proper relation. This, however, is scarcely possible in club-foot of long standing, having served already in locomotion. In those, we find the malposition of the foot much greater, and the bones themselves materially altered in shape. With this explanation, we shall readily reconcile the apparently contradictory reports of Glisson, Camper, Joerg, Clossius, McKeever and others on one hand, and those of Paletta, Cruveilhier, Loeb, Tovrtual, Little, W. Adams, Weiss, and Brodhurst on the other. The results of the anatomical investigation of the former resolve themselves in the following aphorisms:—

1. That the primitive formation of the bones is unnatural and incomplete.

2. That the bones, being originally imperfectly formed, become injured and distorted by causes independent of the formative process, viz., by pressure, occasioned by the fœtus itself drawing the limbs into unnatural positions; by an improper situation of the fœtus in the uterus; or by certain ligaments becoming elongated, and the articulation distorted; from contraction of some of the muscles and relaxation of others.

3. That, whatever may have been the condition of the bones on the occurrence, the act of walking displaces and injures them.

Glisson and Camper ascribe varus chiefly to malformation, and even destruction (?) of the *astragalus*, and hence they pronounce it incurable; Blumenbach,* to an *unnatural shortness* of the neck of the same bone; Naumburg† and Wenzel,‡ to both *malformation* and *displacement;* Bruckner, to *partial dislocation* of the tarsus. The observations of the just-named authors refer, of course, *to old and advanced cases.*

Scarpa§ seems to have examined a younger subject with club-

* Geschichte und Beschreibung der Knochen. Göttingen, 1786.

† Abhandlung von der Beinkrümmung. Leipzig, 1796.

‡ Dissertatio inaug. de talepedibus varis. Tübingen, 1798.

§ Memoria chirurgica sui piedi torti congeniti dei fanciulli e sulla maniera, etc. Pavia, 1803.

foot; for he observed only *slight deformity* of individual tarsal bones. The scaphoid, cuboid, and calcaneus were displaced; whereas the astragalus was *least affected*, and in *almost proper situation*.

W. Adams* has recorded the dissection of two cases of infantile varus, to the effect that there are but *immaterial changes* of the tarsal bones, and in this respect fully confirms the views of Dr. Little: "The deviation of the os calcis is next in extent to that of the navicular bone." In a sound foot, the round head of the astragalus is principally supported by the inferior scaphoid ligament. In severe varus, however, the anterior extremity of the os calcis is forced inwardly as far as the round head of the astragalus, and occasionally beyond it, taking the office of the calcaneo-scaphoid ligament; the posterior extremity of the os calcis is consequently directed outward toward the fibula.

Dr. Little, in his lectures,† gives the following information of the skeleton of club-foot:—

"An examination of these drawings, Fig. 4, will illustrate the position of the tarsal bones in complete varus. The os calcis is drawn upward; the tibial articular facets of the astragalus and its round head are exposed upon the dorsum of the foot; but the scaphoid, cuboid, cuneiform, and metatarsal bones are not merely drawn toward the sole, but also inward and upward (and sometimes backward); so that the innermost point touches the internal malleolus, and has an articular facet formed on it, occasioned by contact and friction. The superior and external surface of the cuboid is somewhat separated from that of the os calcis; whereas the plantar surfaces of these bones are turned toward each other, leaving a space between them externally."

FIG. 4.

* Transactions of the Pathological Society. London, 1852.

† On the Nature and Treatment of the Deformities of the Human Frame. London, Longman, 1853, and copied from Little.

And again, Little says:—

"An attentive study of anatomy, in talipes varus, will further confirm the opinion of its origin, *that the muscles are the parts primarily involved.* If the bones were simply arrested in their development, or if they had been injured by external causes, and the contraction of muscles were but secondary, the bones would not bear so precisely a relation to the action of the muscles inserted into them. The preparation from which the drawings are taken shows that the shortening of the gastrocnemius muscle corresponds to the elevation of the heel, while the adductor and the remaining muscles on the posterior and internal surfaces of the ankle have drawn the navicular, cuboid, cuneiform, and metatarsal bones upward and posteriorly away from the astragalus, exposing its round head. In fact, the conjoint powerful action of the gastrocnemius and the other has bent the foot at *the summit* of its tarsal arch, drawn its component parts asunder while the ligaments were yet soft."

The anatomical relations of the tarsal bones are delineated with much more plainness and accuracy by our esteemed friend Bernhard E. Brodhurst,* than by either of the preceding authors. Brodhurst says the os calcis occupies almost a *vertical position*, being drawn upward by the gastrocnemius muscle, and is also slightly *rotated outward.*

The astragalus follows the calcaneus, and is slightly rotated outward; it also undergoes displacement in its vertical axis; its inner surface tending to assume a direction forward, and its external surface a direction backward, and by reason of its position between the malleoli, they are carried along with it, the internal malleolus being moved forward and the external backward. The superior articular surface of the bone is imperfectly covered by the tibia; indeed, it may remain entirely uncovered, and be thrown forward on the dorsum of the foot. The astragalus being articulated with the os calcis, is slightly rotated together with it. It undergoes consequently a twofold displacement—*first in its long axis*, through its attachments with the calcaneus; and *secondly in its vertical axis.* The scaphoid bone is drawn in and upward, and its tubercle may be in contact with the internal malleolus. And the cuboid with the cuneiform bones, as well as

* On the Nature and Treatment of Club-Foot. London: John Churchill, 1856.

the metatarsus and phalanges, necessarily follow in the abnormal direction.

Now, gentlemen, let us look into the matter ourselves, and judge without the optical assistance of anybody else. We have before us the skeleton of a confirmed high-graded club-foot* of the right extremity. The bones are fully developed, and the epiphyses firmly united with their respective diaphyses; it has therefore belonged to an adult. The gracility of the bones seems to indicate the female sex; it may, however, be also due to impeded growth and nutrition. In comparing the specimen with the skeleton of a normal foot, alongside of each other, we can have no difficulty in discriminating their respective differences. Aside from their slender forms, there is no deviation from the normal type in the bones of the leg; but the articular surface of the tibia, when viewed posteriorly, exhibits a slanting toward the internal malleolus. Astragalus and os calcis have almost preserved their normal relation toward one another, although individually they are materially altered in shape. The relation of these two bones toward those of the leg has undergone a marked change. Their longitudinal diameter is continuous with the axis of the leg, and the tibia rides upon the posterior part of the astragalus, instead of occupying its superior or trochlear surface. In other words, both bones conjointly occupy a completely vertical position instead of a horizontal one, and the entire superior surface of the astragalus presents itself on the dorsum of the foot, and stands in the same plane with the anterior surface of the lower extremity of the tibia. This is then essentially a subluxation of the tibio-tarsal articulation. There is no lateral torsion or inclination of the astragalus, either in or outward. The head of the latter and the anterior extremity of the calcaneus have a downward direction, in fact come in contact with the floor. The posterior extremity of the os calcis is turned upward in conformity with the traction of the gastrocnemius muscle.

The next malposition concerns the cuboid and scaphoid bones; their articular relations are entirely changed. The former has left the articulating surface of the os calcis, and has formed a new articular facet inside of that bone, and in doing so the cuboid has rotated on its axis ninety degrees; so that in its pres-

* A present of my esteemed friend, Prof. Richardson, of Toronto.

ent position it forms a right angle, and its external surface rests upon the ground. This, then, is a complete luxation of the cuboid bone. A similar change in the position of the scaphoid bone has been effected, having left the articular surface of the head of the astragalus, and taken an entirely new position at the inner circumference of the caput astragali, upon which a new articular facet has become established. The scaphoid bone occupies now a vertical direction, and its internal extremity is thus almost brought in contact with the internal malleolus. This is again a true and complete dislocation of the navicular bone, and it might be said to be a dislocation of the first intertarsal articulation.

The relations of the three cuneiform and the fourth and fifth metatarsal bones remain unaffected. They are, however, carried along by the cuboid and scaphoid bones, and thus it comes that the fifth metatarsal is the lowest, and the first the superior in position.

Between the metatarsal and the first row of the tarsal bones there seems, however, a slight twist, and an upward-tending inflection. The twist is most marked at the fifth metatarsal bone, which overlaps the fourth, as if in pronation; and by the inflection of the metatarsus upon the tarsus, the tuberosity of the fifth metatarsal bone protrudes abnormally.

Our observation materially accords with those of Brodhurst, and where they clash it is mainly due to the differences existing between specimens of different degrees of malposition.

A mere glance at the specimen before us, Fig. 5, renders it obvious that the two tibial muscles have been at work to accomplish the dislocation of the tarsal articulation and the extensor muscle of the foot, to turn the calcaneus, and with it the astragalus, around its transverse diameter, and to force them conjointly into a vertical position. It commonly happens that if, for some cause or other, a muscle or its tendon is forced into an abnormal position, its action is thereby misdirected. Thus in club-foot, the adduction of the foot by the tibiales muscles displaces inwardly the insertion of the Achillis tendon; and the subsequent action of the triceps must necessarily tend to increase the adduction. On the other hand, and in valgo equinus, the triceps muscle is converted into an abductor, coöperating with the

peronei muscles. If either the tibialis posticus or peroneus longus and brevis leave their respective grooves behind the malleoli, they may eventually be turned into flexor muscles of the foot, instead of extending it. And once I observed the lateral displacement of the quadriceps femoris by a distended subcruræan bursa, which caused that muscle both to bend and to knock-knee the extremity.

Having thus, from post-mortem appearances, conclusively demonstrated the fact that, as a general thing, the contractions of muscles are the chief, if not the sole, cause of talipes varus, it remains now to be shown which muscles are involved in the malposition.

FIG. 5.
a. Astragalus; *b.* Calcaneus; *c.* Scaphoid; *d.* Cuboid.

First and foremost, I have to mention the *triceps suræ* (gastrocnemius, soleus, and plantaris), which, through the Achillis tendon, have a common insertion in the tuberosity of the calcaneus.

At first sight it does not seem as if the triceps muscle was contracted at all. This comes from the rotation of the foot, by which the points of attachment of that muscle approximate each other. In order to show its full contraction, it would be necessary to reduce the rotation, which, of course, cannot be effected without first dividing the adductor muscles of the foot. This counterpoise seems to be the reason why the triceps muscle can never attain so great a retraction in varus as in equinus; for *the greater the extension of the foot, the less possibility exists of rotation, and vice versâ.*

The idea has been prevalent among some surgeons that the

Des Vites Congénitaux de Conformation des Articulations, page 34.

triceps was the chief, if not the exclusive cause of varus, and they have consequently contented themselves with dividing the Achillis tendon as a sufficient remedy.

This is, however, erroneous, both in a theoretical and clinical point of view. The movements of our own feet clearly denote the extensor muscle as designed to raise the heel and to lower the toes. For this reason the Achillis tendon descends to the posterior extremity of the os calcis in a central position, equally distant from either malleolus. In club-foot, to a certain extent, the triceps is converted into an *adductor muscle;* that is to say, after the Achillis tendon has been pulled more inward from its normal position in the axis of the leg, it cannot fail in assisting the prejudicial action of the tibialis muscles in adducting and rotating the foot. Club-foot, being dependent on both the abnormal pronation and extension of the foot, can, of course, not be completely relieved by the division of but one group of muscles. And gentlemen indulging in those erroneous views, often experience some serious trouble with reference to the tuberosity of the fifth metatarsal bone, which, they say, becomes very painful. The secret resolves itself in the fact that the division of the Achillis tendon alone does not overcome the inward rotation of the foot, and does not diminish the tarso-metatarsal infraction; and that consequently the external margin of the foot still touches the ground at the said tuberosity, causing pressure and tenderness.

The most conclusive disproval of the aforesaid error is talipes equinus itself. I leave it to those surgeons to conciliate their views with that pathological and rather stubborn fact.

Next to the triceps, the *two tibiales muscles* are implicated in this deformity. The tibialis posticus is sometimes so much contracted as to be forced out of its groove from behind the internal malleolus, and to appear outside or even in front of the latter, becoming actually, therefore, a flexor muscle of the foot. The tibialis anticus is generally the more tense; the displacement of its tendon is noticed toward the front of the foot. The shortening of both or either of the tibiales muscles is *the cause of the rotation of the foot.* If their contraction is not the same in amount, the shorter tibialis will so much obscure the longer as to make its implication dubious. But as soon as the

former has been divided, the contraction of the other becomes at once apparent. At last most of the plantar muscles are contracted; their shortening accounts for the longitudinal contraction of the foot and the increase of the plantar arch. We scarcely need specify them, inasmuch as most of them constitute one bundle, with the plantar aponeurosis.

The inversion of the toes in club-foot does not exclusively depend on the malposition of the foot in the tibio-tarsal articulation, nor on the infraction of the same, but conjointly on the two, and on *the rotatory looseness of the knee-joint allowing the tibia to turn on its axis.* That this is *a fact*, you can readily ascertain by taking a firm grasp of the thigh and foot, and turning the articular faces of the knee-joint upon each other. That *relaxed condition of the knee-joint* generally continues for a long while, and even beyond the actual treatment and amendment of the deformity, so that the patient may still invert his toes with his foot restored to normal shape. It requires, therefore, special attention, lest we risk the return of the original difficulty.

Another inconvenience may result from the undue mobility of the knee, namely, *posterior inflexion* of the knee-joint. In ordinary varus this does not often occur, whereas it is more frequent in the lower grades of equino-varus, in which the extension of the foot exceeds the rotation. The patient resorts to posterior inflexion as an *expedient* to approximate the points of insertion of the triceps, and to bring the heel to the ground.

The four specimens of talipes varus which I now exhibit, illustrate different grades of the deformity. The one of a child, but a few months old, shows the least; the next, that of a boy seven years of age, Fig. 6, is essentially equino-varus—that is to say, extension of the foot prevails, presenting but a moderate deformity, although it has served for locomotion all the time, and confirming, therefore, the axiom I have tried to establish, that the greater the extension, the less the rotation of the foot; the third, the most *complete varo-equinus* (Fig. 7) you ever can meet, is derived from a girl twelve years old; and the last (*vide* Fig. 3), as already stated, belongs to a man who was twenty-seven years old when he came under my charge. The last I almost completely relieved, whereas the foot of the girl derived but little benefit, it being the most obstinate case I ever

took charge of, from the fact that the bones had become greatly changed in their respective forms.

FIG. 6.

FIG. 7.

I deem it, for the practical objects of our lectures, entirely unnecessary to qualify different degrees of talipes varus, or lose

any time with the mixed forms. In knowing the fundamental forms, you cannot fail to discern their complications.

The specimen upon the table will also enable you to form an idea as to the *awkward gait* of persons thus afflicted, and by bearing in mind that the deformity is still more aggravated by the *unequal length* of the extremity, you will realize the serious impediment in both appearance and locomotion of the patient. The preceding remark does not, of course, apply to double club-foot, in which the length of both extremities is mostly the same, and in which the walk is differently impeded.

As to the *usual causes* of club-foot we have *no positive knowledge*. Of the 1,218 cases of talipes enumerated by Lonsdale,* 688 were congenital varus. That figure informs us first of *the frequency of talipes varus*, being more than 50 per cent. of all deformities of the feet; and secondly, of their *congenital origin*. But what the cause of congenital varus actually is, we do not know. Some authors have indulged in the speculation that the position of the fœtus in utero is not unlikely the prominent source of club-foot.

It seems hardly necessary to refute the hypothesis of Cruveilhier, as its fallacy is almost self-evident. The uterus is, for the average fœtus of six and a half pounds in weight, a rather limited space, and the latter has therefore to accommodate its form to the uterine cavity, the limbs being drawn up to the body, and the plantar surfaces turned toward each other. This position, more or less, the fœtus maintains even for some time after birth. If that was a sufficient cause for club-foot, almost every child would exhibit it; in fact, since the uterine position is a common one, varus should be the normal form of the foot.

The statistical tables of Duval, if, indeed, they are at all necessary in aiding our daily observations to the contrary, prove that but one club-foot occurs in a population of 3,000 in France.† Certainly this does not speak in favor of Cruveilhier's theory. Moreover, the lower extremities in general participate in the crooked position of the fœtus in utero, without their becoming deformed. And, in fine, the anatomical conditions in club-foot demonstrate that the bones are not acted on by the uterus; and

* Medical Gazette. London, 1849.

† Traité Pratique de Pied. Bot., 1834.

upon the muscles it can scarcely be presumed to have any lasting influence. I can well comprehend that the position of the fœtus may for a short time prevail, but that would not be termed club-foot, since by mere manipulation we succeed in correcting it.

Delpech traces club-foot to arrest of development, and he endeavors to render his suggestion plausible by referring to an incidental coexistence of club-hand, hare-lip, cleft-palate, and other defects, with club-foot. But the anatomical condition of the latter is the best answer to such untenable speculations.

After mature deliberation, I have come to the conclusion that the cause, in congenital as well as in acquired club-foot, is preeminently defective innervation; and there is truly no reason why derangements in the nervous system should not take place in the fœtus as well as in a newly-born child. In club-foot the tibial nerve is the bearer of the difficulty, as must be inferred from the experiments of Bonnet.

The acquired instances of club-foot are comparatively rare, and they depend most unquestionably on impediments and lesions of the spinal cord. We can discriminate two forms of acquired varus. The active form is the less frequent, consisting in reflex action in both extensors and adductors. The extensors most usually preponderate, and we see therefore equino-varus; and the passive form as a sequel of motor paralysis.

General experience on club-foot, etc., has settled the previous doubts. It is now generally admitted that all forms of varus are caused either by muscular contraction or motor paralysis, and that the individual bones of the foot yield only so much in their respective positions as they are forced to do by the abnormal muscular traction and the superincumbent weight of the body. But, being held for some time and acted upon in that preternatural position, they gradually mould themselves accordingly, and become consequently malformed. That this is less the case in the lower grades of malposition of this kind, and more in aggravated deformities of the foot, must be self-evident, and requires no further proof.

The prognosis of club-foot is governed by the same general considerations as that of talipes equinus. It should, however, be remembered that in the latter we have rarely to contend with

any malformation of the bones. At any rate, the local obstacles to re-formation and reposition of the foot are of a simpler nature. The same holds good also in recent cases of varus, in which the prognosis is comparatively favorable. But the highet grades of club-foot already used for locomotion are certainly severe tests for the patience, endurance, and perseverance of both the surgeon and his client; and years may be required to achieve a moderately good form and position of the foot, while the attenuation and impeded growth of the extremity may even remain *in statu quo.*

The age of the patient is thus far of prognostic importance, as it implies both previous locomotion of the distorted extremity and increasing hardness of the bones. I have, however, observed some exceptions to that rule, and found some cases of varus of more advanced age more manageable than in younger individuals, the grades being the same. Malgaigne's opinion that a club-foot of eighteen years' standing has absolutely passed recovery, is but conditionally correct.

In general, however, talipes varus constitutes a formidable and variously complicated deformity, and its eventual relief an object of skill and perseverance for the surgeon. I have purposely emphasized this remark in order to counterbalance the still-prevailing opinion of some practitioners, that club-foot was a distortion readily overcome by dividing the Achillis tendon and applying Scarpa's shoe. The want of experience qualifies such an assertion, and I have good reason to believe that in so comfortable a way not one single club-foot has ever been cured.

Whenever a case of talipes varus is placed under your charge, I beg to advise you to weigh carefully in your mind all its constituting difficulties: its degree, the condition of the bones, the state of the extremity in general, the age of the patient, and the determination of the latter, or the relatives, to have the cure accomplished; for their good-will is certainly indispensable to the ultimate result. And according to all this, shape your prognosis. In doing so, you will protect yourself against insolence and disappointment.

III.

TALIPES VALGUS.

Symptoms.—Causes.—Prognosis,

The latter term has been given to this deformity on account of the breaking down of the plantar arch, and the more or less complete flattening of the plantar surface which comes in contact with the floor at almost every point. In the higher grades of paralytic valgus, the foot may be turned on its longitudinal axis so much as to convert the internal margin into the sole (Fig. 8).

Valgus is a frequent deformity of the foot, from the fact that, irrespective of the other morbid causes, it is evidently the inheritance of the African race. The lesser grade of valgus is indeed so common among negroes as to constitute the normal type. Sometimes it is associated with knock-knee. Next to the negroes, valgus is often met with among the Jews, more particularly in those countries where their race is preserved by the legal prohibition of intermarriage with Christians.

FIG. 8.

Besides this hereditary origin, we observe this deformity as a frequent result of diseases of the spinal cord, or, as it sometimes appears, from an exclusive paralysis of the tibial nerve.

A small, fractional part of the cases of valgus is to be attributed to inflammation of the ankle-joint. If not mistaken, I was the first who called attention to the fact that morbid reflexion connected with the affection of the tibio-tarsal articulation was the proximate cause of that symptom.

Anatomically speaking, valgus exhibits diminution of the

niched arches of the foot. The otherwise receding tibial margin of the same, protrudes to a greater or less degree. In looking down upon flat-foot, it seems to be infracted in two directions: first, from upward downward; second, from the external margin toward the internal. The anatomical relations are consequently reversed. The foot is rotated on its longitudinal axis to such an extent as to lower the internal margin and raise the external. In the higher degrees, and in long-established cases, the patient may step upon his tibial margin, and, more especially, upon the protruding scaphoid bone. If there be a great relaxation of the internal lateral ligament, as is usually the case, and the articulation be loose, the astragalus is somewhat turned and inwardly inclined so as to constitute a subluxation. The infraction of the foot seems to be placed between the first and second rows of the tarsal bones. The toes are everted, and the external malleolus buries its contours in the external tarsal fossa. The extremity is generally attenuated; and, when paralysis is the cause of the deformity, likewise arrested in development, so as to differ in length with its fellow. In a measure, however, the difference must be ascribed to the altered form of the foot itself, which loses in its height from one-quarter to three-quarters of an inch.

I have already indicated the causes of the trouble, and assigned to maladies of the nervous system the greater share. It is indeed remarkable that apparently moderate affections of the brain and spinal cord during dentition should give rise to so serious consequences. In hundreds of cases I have had under my charge, at least ninety per cent. could be traced to the dentitial period; and in the larger proportion the premonitory symptoms were so insignificant as to be entirely disregarded by parents. Sometimes there was but a slight catarrh of the respiratory or alimentary organs; at others, it was preceded by mere uneasiness. Many children have been put to bed in an apparently healthy condition, and taken up paralyzed next morning. In a few cases inflammation of the meninges of the brain or spinal cord, attended by convulsions, had given rise to the paralysis, which was then of a more extensive character, involving either one side of the body (hemiplegia), or the lower half (paraplegia); and in these cases talipes valgus is but one of the resulting deformities. In paraplegia depending on direct pressure of the spinal cord by posterior cur-

vature of the spine, talipes valgus is rarely observed, whereas I have met equino-valgus in fractures of the vertebral column at its lumbar portion.

In all these paralytic or passive forms of valgus we find the tibial nerve, and consequently the adductor muscles of the foot, completely paralyzed; the peroneus nerve having either preserved its vitality or subserving morbid innervation. In the former, the abductor muscles are only physiologically contracted, on account of the antagonistic muscular group being disabled; in the latter, reflex action has established a tonic and permanent contraction of the peroneus muscles. The difference between these two forms of active and passive valgus can be easily discerned by substituting the hand for the physiological action of the two tibial muscles. If the foot can be brought in this way into a correct position, and held there by mechanical means, you have the passive form of valgus, and *vice versâ*.

Talipes valgus, originating in inflammation of the tibio-tarsal and tarsal articulations, is always of an active character, depending invariably on reflex contractions of the peroneus muscles; but not every inflammatory process in those joints gives rise to this deformity. From an extensive field of clinical observation, I have elicited no exception; and I never met with a reflex contraction of the tibial or any other muscle of that region. In paralysis, I have incidentally observed reflex contractions of the flexores digitorum.

The lightest forms of talipes valgus are those of a consecutive mechanical character, as in genuvarum; but they are nevertheless very troublesome, painful in a high degree, and may even lead to inflammation of the tarsal bones.

The prognosis of valgus is governed by its producing causes. Generally the paralytic forms allow of only a doubtful prognosis. The more complete and extended the palsy, the less the hope of recovery. Progressive improvement of the principal disease, increases the chances in behalf of the valgus. We may amend the distortion and render locomotion more easy by mechanical appliances, but, of course, this does not constitute a cure: because we cannot restore by these remedies the altered structure and lost tonicity, nor directly invigorate the arrested growth and development. In fact, beyond replacing and keeping the tarsal bones

in their respective positions, and supporting the plantar arch, we can do nothing by orthopædic treatment. For these weighty reasons our prognosis should be cautiously given.

It is certainly true that paralytic affections in children are not of so grave a nature as in adults and in people of more advanced age. Their powers of repair are greater; the skull and spinal column are yet soft or more pliable, and capable of accommodating themselves to exudations, apoplectic clots, etc., and hence spontaneous improvements are frequent. Notwithstanding all this, perfect recovery from paralytic valgus is one of the rarest occurrences. The more recent a case is, the more early a general and local treatment is resorted to; and the more limited the paralysis, the more favorable certainly is the prognosis.

Talipes valgus, produced by an inflammation of the tarsal and ankle joints, admits of a favorable prognosis, at least in as far as the deformity is concerned; and in general if the inflammatory process has not too deeply involved the interested structures. The division of the peronei muscles and the reposition of the foot act like a charm, and afford more relief than all the antiphlogistics that may be brought to bear upon the diseased structures.

Talipes valgus, dependent on knock-knee, allows an equally favorable prognosis, provided the case is not of too long standing, and the form of the bones not too materially altered.

IV.

TALIPES CALCANEUS.

Symptoms.—Causes.—Prognosis.

The term "talipes calcaneus" has been given to that rare and very singular distortion, in which the posterior circumference of the os calcis exclusively rests upon the floor, and the foot is unduly flexed (Fig. 9). I have met with but few well-authenticated cases of this species. Some years ago I noticed a boy on one of the Hoboken ferry-boats afflicted with this deformity. He peddled small articles to the passengers; and, enlisting the sympathies of the passengers with his affliction, he did a thriving business. The deformity was fully as bad as the diagram

indicates. The patient put so high a commercial valuation on his distortion, that he derisively rejected my offer to cure him free of expense. Nay, he would not even allow a mould of his foot to be taken.

FIG. 9.

At the consideration of $1, I was graciously permitted to examine into the details of the foot. The angle of flexion certainly did not exceed 30°. The toes occupied almost a vertical position, and the posterior part of the heel rested on the floor, and had become covered with thick callous substance. Although the extremity was decidedly shorter than its fellow, from the arrest of growth, yet the protrusion of the heel served as a substitute for the deficiency. The extensor muscles of the foot (gastrocnemius and soleus muscles) were completely paralyzed, their belly soft and undefined, the Achillis tendon flaccid; whereas the tibialis anticus, peroneus tertius, and flexor digitorum longus, were intensely contracted, so as to raise even the transverse ligament. Any attempt to extend the foot met with insurmountable resistance on the part of the contracted muscles, whereby the toes bent back. The plantar arch was *not materially changed*, and, if at all, it was *diminished.*

Evidently the tibia was riding upon the anterior surface of the trochlea of the astragalus, and its superior surface seemed to be continuous with the posterior surface of the tibia. This anatomical relation accounts readily for the great downward protrusion of the heel. The affected extremity presented in every other respect the *usual symptoms* of talipes.

With reference to talipes calcaneus, my experience is limited. I am at a loss to say whether the majority of cases are congenital or acquired. In that patient it seemed to be of congenital origin, and obviously caused by paralysis of the triceps and contraction

of the three principal flexors of the foot. But I must candidly confess that, if I had not known that there was such a thing as talipes calcaneus, I should have been strongly inclined to pronounce it posterior dislocation of the foot, so much had it that appearance.

At any rate, it cannot escape your notice that talipes calcaneus is the exact reverse malposition of talipes equinus.

Some authors, more particularly Little, have observed combinations between talipes calcaneus, varus, and valgus, which are caused by the prevailing contraction of one of the flexors of the foot over the other. Such complications have received the name of calcaneo-varus and calcaneo-valgus.

The same author relates also a case of calcaneus produced by an extensive scar in front of the ankle, from a burn.

From all I have been able to gather about this subject, the prognosis seems to be rather favorable, provided the case be not of too long duration, and the bones themselves malformed.

V.

TALIPES SIMPLEX SIVE PLANTARIS.

I introduce with this new term a variety of talipes which hitherto has been, and inappropriately, comprised under the head of talipes calcaneus. With the assistance of the diagram (Fig. 10), you will readily realize the characteristics of this form, being an inflection of the foot at its tarso-metatarsal articulation. The dorsum presents an abnormal degree of convexity, with a corresponding hollowness of the plantar. The heel and ball approximate each other, and the wetted foot leaves but the marks of these parts on the floor, to the exclusion of the external margin. The transverse arch is entirely lost. The foot is shortened in proportion to its inflection. The prompting cause of this deformity is the contraction of the plantar muscles inserting themselves into the plantar fascia; the motor apparatus of the foot is otherwise in

FIG. 10.

perfect order. There is, indeed, no concurrence between this variety of talipes with calcaneus, hence the new term. It is but rarely congenital, and, according to observation, produced by the wear of short boots. From this cause arises this species of talipes among the Chinese women of the higher order. Not unlikely it may be occasioned by synovitis of the intertarsal joints, as it gives birth to it.

The prognosis is ruled by the degree and duration of the distortion. If the bones of the tarsus are not materially compromised, there is no great difficulty of remedying the same.

We meet occasionally distortions of the feet which cannot be placed under the preceding heads. Such a one I exhibit in this plaster-cast (Fig. 11), taken from a boy nine years of age. It is alleged that it resulted from an accident by stepping, heel foremost, between two planks, which forced the foot into an extreme flexion. Though there remained some tenderness of the foot, yet it does not appear that the continuity of any part had been dissolved. The deformity had been several years in existence when I was placed in charge of it. First, you notice the great distance between the heel and the axis of the ankle-joint. It would seem from this, as if the tibia and fibula had glided forward on the trochlear surface of the astragalus. Next, there is the slight flexion of the foot, which I found to be permanent, from the contraction of the tibialis anticus and peroneus tertius muscle. Then, there is a considerable projection of the scaphoid bone, and a loss of the plantar arches. And, in fine, there is the extreme flexion and abduction of the large toe, forming an angle of 125° with its respective metatarsal bone. In some respect (abnormal flexion) the deformity might be grouped with talipes calcaneus; in another (loss of arches and prominence of scaphoid bone), it approximates talipes valgus; but there is scarcely any longitudinal rotation, nor any infraction of the tarsus. And again, the abnormal position of the large toe remains outside of the prototype.

FIG. 11.

If there is such a thing as subluxation of the foot, this deformity represents it; and the fact seems to bear out such an opinion, that the mobility of the ankle-joint never became free, though the deformity was successfully relieved by tenotomy and mechanical means.

FIG. 12.

The malposition of the toes (abnormal flexion or extension) is but rarely presented as an object for treatment. But the large toe is occasionally so badly jointed and distorted that it impedes locomotion, occasions pain, and disfigures the foot. Such a case I present in the diagram (Fig. 12). This is an extreme case, and you readily observe that it must have almost disabled its owner. Unfortunately, the patient was too old to admit of any other treatment than exarticulation.

Bursitis, synovitis, gout, and pressure by narrow boots, bring about this deformity.

The prognosis is not very auspicious, since the deformity happens almost exclusively in individuals advanced in age, whilst aid is sought after a protracted continuance of the trouble.

CHAPTER III.

TREATMENT OF TALIPES.

Difficulties in the way of successful relief.—Tenotomy but an initiatory surgical step.—Mechanical apparatus not to be depended upon.—The hand of the surgeon the most reliable reformer.—Tenotomy and myotomy.—Differences in the healing of subcutaneous and open wounds.—Modus reparandi of divided tendons.—Antispastic effects of myotomy. —History and technical rules of tenotomy.—Mechanical treatment of talipes.

GENTLEMEN:—In our discussion on the prognosis of talipes, I have enumerated the chief points of difficulty in the way of its perfect relief. If you have attentively followed, you must have become aware that the treatment of talipes is by no means as trifling as some surgeons make it appear. The steady advancement of surgical art has indeed greatly facilitated success; yet we meet with morbid conditions in the deformities of the feet, over which we can exercise but an indirect therapeutical influence. And for that reason, we should enter upon the treatment of those afflictions with correct views of their intricacy. Do not overestimate your ability, neither shrink from difficulties which perseverance and skilful management may overcome. Bear in mind that the division of contracted muscles is but *one of the remedies* we employ in the treatment of talipes, and which alone but rarely suffices. The operation of tenotomy most certainly is a great aid; but the after-treatment is equally, if not more, important. In taking charge of a case of talipes, we should be unremitting in attention, and never leave to unskilled hands the mechanical adjustment of apparatus. In making rational use of all auxiliaries placed at our disposal, we serve both our patient and ourselves, and stand above blame in case of failure. For this appeal to your honor and duty, there is a good pretext from experience. I am cognizant of facts that poor sufferers, after having been skilfully operated on by eminent surgeons, were turned over to

unskilled students for after-treatment. The cases naturally not only failed, but the failure greatly contributed to their aggravation and incurability. There is no reason why students should not enjoy the privilege of witnessing operations of this kind, and benefit by observing the mode of after-treatment. The latter requires, however, a well-trained hand; and I would rather assign the operation to a student than the after-treatment.

The general treatment of talipes resolves itself into the following indications:—

1st. The removal of muscular impediment.

2d. The reposition of the tarsal bones to their normal location.

3d. The re-establishment of the motor power.

4th. The promotion of nutrition, growth, and development of the affected extremity.

In young subjects, muscular contraction constitutes the *chief*, if not the only *cause* of most cases of talipes; their division is therefore *the chief and sufficient remedy* for the re-establishment of form and position of the foot. All that remains to be done besides tenotomy, is to keep the newly acquired position by appropriate appliances.

If the bones of the tarsus are malformed, as is usually the case in patients of some age, who have employed their affected extremity in locomotion, the second indication presents itself as the next object of treatment. The means of replacing the tarsal bones are the hand and mechanical appliances. The former is of invaluable service. Without causing any painful pressure or contusion, the great power of the hand can be concentrated at any place where it is needed; and the more assiduously it is employed, the more rapidly the bones will yield. *There is no mechanical apparatus, however ingeniously constructed, that could be substituted for the hand in the mechanical treatment of talipes with an approximate degree of efficacy.* In fact, could we, without interruption, employ the hand as a mechanical agent, we would relieve most obstinate forms of talipes which but too frequently withstand mechanical appliances. These latter we resort to as mere auxiliaries, and for the time that the hand cannot be used. Between the two, the mechanical treatment should be divided; and proper care should be taken that the apparatus is always

properly adjusted, so as to act effectively in the intended direction. In order to accomplish this, the patient should be constantly under the eye of the attending surgeon, or of a competent substitute, and the propriety of placing a patient in an orthopædic institution suggests itself most forcibly. For, to patients or nurses such a duty cannot be assigned; they are neither competent, systematic, nor resolute enough.

To a certain extent, the remedies previously suggested comply also with the 3d and 4th indications. It is a common observation of orthopædic surgeons, that the relief of contracted muscles by tenotomy reacts most favorably upon the nutrition of the afflicted extremity, and nutritive supply promotes self-evidently its growth and development. Passive motion coöperates in the same direction.

We may, however, do more to promote the motor power still extant, or maintain the fast deteriorating structure of the affected muscles. The most efficacious remedy in behalf of innervation is electricity and Faradayism. It should be used with assiduity every day, and for months in continuation; it will prevent structural decay and stimulate the existing mobility; you can concentrate its action upon single muscles and muscular groups; and, by perseverance, establish muscular action where none existed before. Electricity is the substitute of volition, and the best local gymnastic agent. Next are friction with alcoholic liquids; with phosphorated oil (phosphorus, gr. iij. dissolved in an ounce of warm almond-oil); the use of the flesh-brush, with or without cold irrigation, and such internal remedies as the case may suggest. Proper care should be taken to aid the generation of animal heat in the affected extremity, by advising the use of worsted stockings or flannel bandages. Besides this, a proper hygienic regimen should be observed, to promote the constitutional health.

With all, gentlemen, you may fail in your efforts through the intricacy of the case. All surgeons have had such experience, even in instances that seem to be promising. Hence, I should advise you never to engage a cure, but simply to guarantee your skill and attention. Your professional dignity and prudence should prevent you from making a promise which you might be unable to realize. For the same reason, do not uncharitably

judge the failure of your colleagues, because they may have done their full duty and failed, where you might have been equally unsuccessful.

I propose now to invite your special attention to the subject of tenotomy and myotomy, and render you conversant with the history, technicalities, and indication of that operation. In doing so at this juncture, I shall obviate repetition.

TENOTOMY AND MYOTOMY.

These comparatively modern operations have, with surprising rapidity, extended the field of their practical utility, and have become most indispensable auxiliaries in orthopædic treatment. Like the ophthalmoscope in ophthalmology, subcutaneous tenotomy has revolutionized the orthopædic branch of surgery, and promoted its effectiveness. The operation is trifling when compared with its results. If properly performed, it is scarcely ever followed by inconvenient symptoms, and the small wound it leaves in the integuments usually closes within twelve hours, by first intention.

Although the tendons receive but a scanty supply of vessels, which diffuse themselves both in the external sheath and internal partition of connective tissue, nevertheless their repair of injuries is rapid and perfect. The experiments of Paget* upon rabbits are conclusive on this point, and confirm the respective observations of Lebert,† von Ammon,‡ Duval,§ Duparé,‖ and Brodhurst. A great difference is, however, noticeable in the reparative process of tendons, according to the mode of their division. In open wounds there is "more inflammation, and more copious infiltration of the parts than in subcutaneous division in the same rabbit." "Suppuration frequently occurs, either between the retracted ends of the divided tendon, or beneath its distal end." The skin is more apt to become adherent to the tendon, and to hinder and limit its sliding movements. The retracted

* Lectures on Surgical Pathology. London, 1853, page 176.

† Abhandlungen der Practischen Chirurgie, page 403.

‡ De Physiologia Tenotomiæ.

§ Bulletin de l'Académie Royale de Médecine, 1837.

‖ Nederlandsch Lancet, 1837.

ends of the endons are more often displaced, so that their axes do not exactly correspond with each other, or with the reparative band of union. The consequences of division may, however, be *reversed* by the skilful operation of the one, and a clumsy one of the other. Thus Paget* accomplished, in one of his experiments, first intention and speedy repair of a tendon of one leg, after an open division; whereas no repair had commenced on the twelfth day in the same rabbit in the other leg by subcutaneous section. That the delay of repair in subcutaneously divided tendons is not alone caused by the improper execution of the operation, we are satisfied from numerous clinical instances; and we believe that generally impaired nutrition is equally apt to favor suppuration of the divided tendon, and hinder the operative result.

The reparative process following subcutaneous tenotomy develops itself generally in such a manner that, at the instant of division, the fragments separate, "*the upper portion being drawn up* the leg, by the action of the gastrocnemius and soleus muscles;" the lower remains opposite the wound. Such a retraction is of course not observed when the divided muscle has lost its contractility. Very little blood is effused in subcutaneous operations, unless large vessels are divided. "Commonly only a few patches of extravasated blood appear in or near the space from which the part of the tendon is retracted." The first apparent consequence of the division of the tendon is the effusion of a fluid or semi-fluid substance, which, like the product of common inflammation, quickly organizes itself into the well-known forms of lymph or exudation cells, speedily becoming nucleated and elongated. The exuded lymph makes the tissues at and near the wound succulent and yellow; the blood-vessels enlarge. Both the exudation and the enlarged blood-vessels distend the parts, so that the skin is scarcely depressed between the separated ends of the tendon. In rabbits, forty-eight hours elapse before the *reparative material* becomes apparent. This is deposited in the connective tissue that lies between and close to the ends of the tendons, as well as in the partitions of the tendinous fasciculi of those ends. It thus swells up the space between the separated ends, and makes them larger, somewhat

* Lectures on Surgical Pathology. London, 1853, page 119.

ruddy, soft, and succulent. This apparently fibrous blastema becomes nucleated, and gradually converted into filamentous structure, and at length may become perfect fibro-cellular or fibrous tissue.

As the bond of connection thus acquires toughness and definite character, so the tissue around it loses its infiltrated and vascular appearance, wherewith the integuments become looser, and slide more easily. In the specimens* presented by Tamplin to the Hunterian Museum of the Royal College of Surgeons, England, the new tissue had to all appearance become identical with that of the original tissue.

As to "the strength of the new tissue, and its connection with the original substance by intermingling," Paget furnishes some illustrations. He removed from a rabbit an Achillis tendon that had been six days previously divided and suspended from a section of the same (longitudinal?) gradually increased weight. It bore for a while ten pounds, and suddenly gave way. In another experiment, the same author employed a tendon that had been severed ten days previously, and he gradually increased the weight to fifty-six before it parted. I can bear evidence to the great strength of the intermediate tendinous substance, having observed but *one case*, and this in an individual some fifty years of age, in which it gave way in a position comprising both the entire weight of the body (162 pounds) and extreme flexion of the foot. Not unlikely, the intermediate substance had remained in a state of fibro-cellular texture.

In the foregoing details of reparation in divided tendons, I have largely drawn from Paget's Surgical Pathology, which gives a most lucid and elaborate exposé of the entire process. The results of his observations, having been derived from experiments with animals whose muscles were in a state of structural integrity, represent only in a very general way the same process in man. In most instances in which surgery resorts to tenotomy as a curative agency, we have to deal with parts more or less deprived of normal innervation and nutrition. Hence the reparative process is more sluggish, and the transformation of the blastema into proper fibrous structure more or less protracted and imperfect. Yet, with all, the intermediate sub-

* Nos. 358, 359, 360.

stance becomes, in the course of time, so strong and tenacious as to subserve the intended purpose. Then, again, the divided muscles and tendons have suffered more or less structural changes, which prevent them from retracting to the same extent as healthy muscles. This fact is worthy of note.

Another circumstance I have to mention as immediately connected with tenotomy, is the subsequent relaxing of the muscular belly a day or two after the section of its tendon, and the consequent approximation of its two fragments. Dieffenbach, I believe, was the first who called attention to this fact; and from that he inferred the antispastic effect of tenotomy. The explanation of the phenomenon is, that after section of the tendon the muscle contracts to the utmost of its capacity, and the excessive contraction subsequently relaxes by being tired out. I have observed analogous facts in the fracture of the patella, the olecranon, etc.

HISTORY OF TENOTOMY AND MYOTOMY.

The first attempt at tenotomy is to be traced to Thilenius, who, in the year 1784, divided the Achillis tendon, after having made a free incision through the integuments. The patient, a girl of seventeen years, recovered, and the operation proved successful. The next operation of this kind was performed by Sartorius, on the 16th of May, 1806, upon the son of Martin Oust. The proceeding commenced with an incision four inches in length through the skin over the tendon; the cicatrices around the joint were carefully dissected off, the tendon transversely divided, and the foot broken straight by main force, whereby a crackling noise was heard. Michaelis, on the 16th of November, 1809, in a case of club-foot, proceeded in a similar manner, with this difference, however, that he only *incised* the tendo-Achillis, rupturing the remaining portion.

The fourth operation of tenotomy was executed by Delpech,* on the 9th of May, 1816. His case was talipes equinus, in an infant two years old. With that sagacity which characterizes the entire surgical career of this truly great surgeon, he recognized the practical advantages of a *smaller* opening through the

* Chirurgie Clinique de Montpellier, tome i., 1823.

integuments, and *remote* from the tendon, and virtually performed thus the first *subcutaneous* division.

Delpech* prescribed the following axioms in the performance of tenotomy :—

1st. The tendon to be divided should not be exposed; its section should be made by entering the knife at a distance from the tendon, and not through an incision of the skin parallel to it. There is danger of exfoliation of the tendon unless this precaution be taken.

2d. Immediately after division of the tendon, the divided extremities should be brought in contact, and so held by a suitable apparatus until reunion is accomplished.

3d. As reunion can only take place by an intermediate fibrous substance, gradual and careful extension should be made to give the required length to the shortened muscles before solidification takes place.

4th. Extension being complete, the limb should be fixed in this position, and there kept until the new substance has acquired that firmness of which it is susceptible.

Although the result in Delpech's case was quite satisfactory, the patient having acquired the proper form and position of the foot, and being enabled to use it in locomotion with firmness and rapidity, it seems that it was the only tenotomy that surgeon ever performed.

Of Dupuytren, it was said that he adopted the plan of Delpech in several cases; but when, and with what benefit to the patient, I have not been successful in finding out.

For about fifteen years the operation of tenotomy was not repeated, when Stromeyer not only resuscitated, but established it at the same time on a secure and permanent basis. His first tenotomy† was upon George Eblers, a young man of nineteen years, resident of the city of Hanover, and was performed on the 28th of February, 1831.

The discovery of Stromeyer, that tendons and muscles might be subcutaneously divided with impunity, opened at once a new and wide field for orthopædic exploits. The prominent surgeons of Germany eagerly took hold of the new operation. The ob-

* De l'Orthomorphie, tome ii., 1828.

† Rust's Magazin. Band xxxix. p. 193. 1833.

servations of Stromeyer were at once and everywhere put to a practical test. Very soon the medical periodicals abounded in praise of the new orthopædic measure, which was unanimously pronounced to be both harmless and efficacious. All cripples in the land were hunted up and invited to obtain relief by the new proceeding. Dieffenbach alone, if I mistake not, performed more than two hundred operations in the course of one year, and other surgeons large numbers, in proportion to their popularity and public trust. From the various scientific centres in Germany, tenotomy radiated with unexampled rapidity to the remotest corners of the civilized world. Enthusiasm ran into a tenotomic fever, which took the character of an epidemic. Experience has established the true basis upon which the operation rests. It has decided the applicability of tenotomy and its contra-indications. It has put in a proper light both its merits and abuses. Since its advantages and demerits have been duly established, it has been recognized and incorporated in scientific surgery.

TECHNICAL RULES OF TENOTOMY.

For the object of the operation it is indifferent from which side a tendon is divided, whether from within or without, provided a small wound be made and proper care be taken to exclude air. Most surgeons prefer, however, to enter with the knife behind the tendon and divide it toward the surface of the body. Some tendons are placed in such close proximity to nerves and vessels that the other way suggests itself as preferable, on account of the lesser danger of injury. Thus, for instance, in dividing the external hamstring one can more readily avoid the peroneal nerve, and consequently paralysis of the peronei muscles, by approaching the tendon externally.

The next technical rule is the appropriate position of the patient. The parts to be operated on should be well exposed to light, well accessible to the hand of the operator, and allow all the changes that may be demanded by the operation.

Further, the extremity requires to be immovably fixed by reliable assistants in a directly *reverse* position to the existing deformity. This precaution is indispensably necessary: *a.* To render the tendon (or muscle) more defined, recognizable, and accessi-

ble. *b*. To raise the tendon (or muscle) off from the adjacent parts, and to render it more divisible. In fine: *c*. To protect the wound against the entrance of air.

These rules are to be so modified as to leave the extremity in the same position, until the tenotome is introduced and has arrived opposite the tendon, if it should be intended to divide the latter from without; otherwise, the tension must be kept up until the operation is finished. The extremity is then reduced to its original malposition. The wound must be carefully closed and covered with a piece of adhesive plaster, and the parts kept at rest. I employ for the latter purpose a leather splint previously softened in warm water, which I fasten with an ordinary roller of woollen flannel. In this state the extremity may be left for three or four days before the after-treatment is commenced. This plan has the advantage of insuring a perfect closure of the wound, precluding the impending danger of air entering when the parts are subsequently handled. Nor is this apparent delay a real loss of time, inasmuch as the reparative process does not usually commence before the fifth day. If, at the end of that time, the wound be found properly closed, I place the patient once more under the influence of chloroform, and by main force reduce the malposition as far as it can be safely done. In breaking up some adhesions, or in tearing some ligaments, one risks nothing, since the anæsthesia seems to protect against reactive consequences.

The requirements for the operation are three or four small narrow-bladed knives, sponges, water, adhesive plaster, a piece of harness leather, and a roller.

The knives have been differently constructed. Some surgeons prefer the sickle-formed (Stromeyer, Dieffenbach); others the straight blades. I use chiefly the latter. A strongly bent sickle-formed blade is certainly not desirable, and a too long and pointed blade is apt to perforate the skin on the opposite side of the tendon from whence introduced. The tenotomes which I have adopted, and which I now exhibit, have square handles three and three-quarter inches in length, and about as large in size as an ordinary pen-holder. The knives are of the best English cast-steel, well tempered, narrow but substantial. The neck is one inch, and the blade one and one-eighth in length. Some of the teno-

tomes should be finely pointed; the others may be blunt. I have in my set straight and convex ones (Fig. 13). The last I use for the division of tendons or muscles from without. Blunt-pointed tenotomes I use for special purposes, in order to ferret

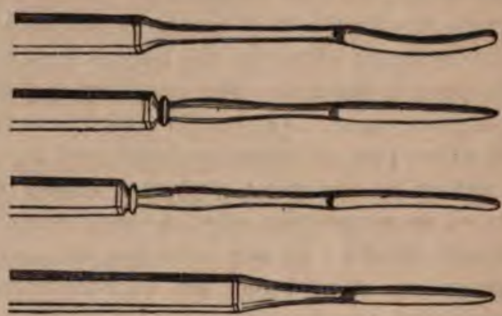

FIG. 13.

out more safely deeper-seated tendons or muscles, using it like a probe.

Having the extremity placed as directed, and under the control of an assistant, take the tenotome like a pen, and insert rectangularly the point through the skin about a line or so from the margin of the tendon or muscle, the surface of the blade being parallel with their longitudinal axis, until you arrive to the depth of the posterior surface of the same. You then recline the handle and push the knife behind the tendon or muscle until you feel the point on the opposite side through the integuments. The knife is then so rotated as to turn its cutting edge toward the structure to be divided, and by short, sawing cuts, but more by pressure, it is to be thus severed. In the moment that the last fibres yield to the knife, the resistance ceases, and with it the peculiar sound that attends it, or, at any rate, that which is heard in the division of a tendon. Having become satisfied that the operation is complete, the knife is to be withdrawn in the same manner as introduced. Otherwise, it is turned against the remaining undivided fascicles and pressed through. For novices, it might be advisable to make the punctured wound through the skin first, and then to use a blunt-pointed knife for the division, which obviates the splitting of the structures. The index-finger of the left hand of the operator should then sweep along the sub-

cutaneous wound, with a view to squeeze out air and blood, and to compress the two edges until covered.

The operation thus described necessitates some modifications in certain places, which I shall mention when speaking of the special application, and exemplifying them by the operations upon subjects.

MECHANICAL TREATMENT OF TALIPES.

I have already stated that the hand is by far the best, the most powerful, and direct mechanical agent. No mechanical appliance bears comparison with it in efficacy. The more freely it is used in reference to the former, the better is the result, and the less inconvenience is caused to the patient. The first handlings of the distorted foot should be made with the assistance of anæsthetics. That spares the patient pain, allows the employment of more force, and protects against reaction. After you have the patient thus prepared, you take firm hold of the leg with one hand and the foot with the other, and by main force you correct the position by bending the foot into the reverse one from that into which it was drawn by the contracted muscles. If you intend to diminish the longitudinal plantar arch, you hold the heel with one and the forefoot with the other hand, and while thus extending the arch you press with the two thumbs the protruding bones down. In a similar manner you may proceed in reducing the transversal arch, with only this difference, that you press upon the most convex part of the external margin of the foot. These are the general rules for handling talipes, and may be repeated as long as the anæsthesia lasts, or as may be deemed safe and practicable. After a violent proceeding of this kind it may be advisable to allow the member some rest, and to apply cold fomentation for a day or so, in order to obviate inflammation; although I have seldom had occasion to resort to them. At a later period, and when the malposition of the bones shows some disposition to yield to the treatment, milder exercises may be made daily once or twice without chloroform, until the malposition is overcome, and every joint moves with ease and normal range.

MECHANICAL APPLIANCES IN TALIPES.

Much constructive genius has been employed by both surgeons and instrument-makers to create mechanical means, combining traction and pressure, with a view of reducing both malposition and distortion of talipes. At a time when the proximate cause of talipes was obscure, and the bones of the foot were supposed to be originally malformed, pressure was diligently applied, and mechanical appliances were of the utmost importance. Almost every surgeon had his own designs; and if I had to reproduce them on this occasion, the various instruments of this kind would fill a large space of this lecture-room. But surgical pathology, and with it surgical operations and mechanical remedies, have become more simplified. And in orthopædy, tenotomy has greatly tended toward that end. Nevertheless, we are still in need of mechanical means to reduce talipes; yet with this understanding, that they are no more the chief, but merely subordinate and auxiliary remedies, and intended to perpetuate the action of the hand. *They possess no positive curative virtues, but retain the foot in the position in which tenotomy and the acting hand left it.* Their effect is greatly enhanced by the weight of the body and the motion of the joints.

Whatever the construction of those mechanical appliances may be to which we resort in the treatment of talipes, they should possess the following qualities:—

1. They should fit well, and most *accurately* conform to the shape of the member.

2. Their respective joints should be exactly located with the *axis of the motion* of the joints they are to subserve.

3. Their action should be diametrically opposite to the traction of the divided muscles, tending to reverse form and position.

4. Their action should be steady, and, while applied, uninterrupted.

5. They should keep the foot firmly upon the sole of the shoe, and should not permit the heel to rise from its place.

A mechanical apparatus with these qualities will fulfil its object, whatever its construction may be.

In concluding the "general treatment of talipes," I have re-

served a few remarks on the subject of extension as applied to this deformity. It is a common experience in the healing art, that remedies of conditional value and serviceable under proper restrictions are generalized and rendered fashionable by misuse and misapplication. The very same has been attempted with the treatment by extension which its enthusiastic advocates propose as a substitute for tenotomy, braces, and the human hand. The claimed efficacy of extension rests on the pathological supposition that:

1st. The contracted muscles are in a state of continuous spasm; or,

2d. That the muscles are merely shortened from the physiological fact of paralysis of their respective antagonists.

These suppositions may apply to a few isolated cases of talipes, but they certainly do not cover the pathological base upon which the generality of talipes rests.

I refer you to the case mentioned, in which permanent and painful spasm of the extensor muscles of the foot was occasioned by a punctured wound into the back, probably striking the spine. This, then, was a clearly representative case, and should have been susceptible to alleviation by extension; but it so signally failed, that I had eventually to resort to the tenotome. To be sure, I did not use the respective plans of extension which Dr. Prince and Mr. Barwell commend; but extension it was, and a most powerful one indeed. Having given the patient the benefit of a full anæsthesia by chloroform, I used my whole manual force to extend the contracted muscles and to reduce the malposition of the foot, and I did this repeatedly without any effect whatever. Now, gentlemen, in this very first test-case, in which there was no doubt as to the existence of spasm and the coexistence of muscular expansibility, extension proved absolutely nugatory. Or do its advocates claim that the extension by their respective methods, amounting in the aggregate perhaps to a few pounds, would have been successful when the traction of a powerful hand, supported by the suspension of volition, failed?

Ever since the so-called new method has been promulgated, I have had ample opportunities to test the principle of extension in the same manner as I have stated; and I have invariably met with the same negative result. The logic of facts has thus con-

vinced me that extension of morbidly contracted muscle is impracticable and worthless. Dr. Prince, in his recent work,* admits as much when he advises (page 184) to use "force" "in cases of obstinate resistance;" that means to perform subcutaneous tenotomy without the knife. At another place I have shown that force unduly applied in the extension of morbidly contracted muscle is a most dangerous undertaking; and I, for one, prefer the knife.

The so-called antagonistic retractions of muscles are indeed of very little consequence, inasmuch as they can be counterbalanced by splints, mechanical apparatus, or, if you please, by the extension which Dr. Barwell and his followers recommend. These cases are but few in proportion. I have seen cases of this nature in indisputable purity. Four times I have inadvertently divided the peroneus nerve, and thus engendered paralysis of the peroneus and extensor muscles of the toes, with consequent formation of talipes equino-varus. And during the last two years I have attended a patient with an injury to the knee-joint, in which the peroneus nerve had been torn away to the extent of one inch and a quarter, resulting in the same malposition of the foot. If there is any such thing as antagonistic muscular retraction it must show itself there, where a group of muscles is completely paralyzed by the disruption of its chief nervous supply.

In none of these cases have I encountered the least difficulty in maintaining proper position by trifling mechanical means. The fact is, gentlemen, that these so-called physiological retractions are of very rare occurrence; whereas, those claimed as such by Bawrell are the coexisting symptoms of paralysis—that is to say, more or less complete suspension of innervation in one group of muscles, and excited morbid innervation in another, with consequent contraction.

From my experience, I look upon the claimed brilliant results in the treatment of talipes by extension, with great reservation.

If extension succeeds at all, it must be in the lightest and most insignificant cases of talipes, and in such where the human hand would equally suffice. We meet with such cases in re-

* Orthopædica. By David Prince, M.D. Philadelphia, 1866. Lindsay & Blakiston.

cently born children, where it would be an absurdity to use the knife at all. But no man can make me believe that he can, and has cured, by the exclusive employment of elastic extension, any one case or number of cases, that could not have been reduced at once by the hand and with the assistance of chloroform. Least of all could anybody convince me that he had reformed the individual bones of the tarsus, and reduced them to their normal positions by elastic extension. The number of cases of talipes that has passed through my hands has not been inconsiderable, and I have indeed succeeded in re-establishing almost perfect forms. But the means employed were adequate to the difficulties. Aside from tenotomy and the mechanical apparatus, I have been working for months, and in one case three years, until I fully succeeded in accomplishing the object. I have not only used my hand, but even the knee-joint, over which I bent and stretched the foot for half an hour at a time, and several times each day, and I can therefore suffer no mystification from whomsoever.

Extension may be an excellent card for the public, as granules and infinitesimal division of medicines have proved to be; but when these offerings are made to the professional palate, they must be rejected as absurd impositions.

I have come therefore to the conclusion, that where extension is admissible, the hand is the better agent; and when the hand is inefficient, extension can effect no good. However, I leave to your own criticism the decision. Experience, after all, is the best test for these mushroom improvements. As yet extension has not succeeded in becoming fashionable with competent surgeons.

I.

SPECIAL TREATMENT OF TALIPES EQUINUS.

The proximate cause of this deformity may consist:—

1st. In a paralysis of the flexor muscles and a mere preponderance of the extensors.

2d. In an active contraction of either the triceps alone, or of the entire group of extensors.

In the former condition, we are able to flex the foot by sub-

stituting the hand. These cases are comparatively rare; and if they have commenced as a paralysis of the flexors, they most generally, and in course of time, terminate in active contractions of the extensors, and become therefore identified with the active forms of equinus. In both conditions, however, the growth of the entire extremity is arrested and its length materially diminished.

Before attempting to remedy the deformity, we have to consider the present locomotion of the patient, and the changes that would inevitably be produced by the correction of the deformity.

If the deformity be just enough to add to the deficient length of the extremity, and renders locomotion perfect, there is no feasible pretext to interfere in any way whatever with the trouble; for the deformity is certainly the lesser evil, and the usefulness of the limb the higher consideration. On this very ground I have refused to treat such cases. In recent cases, however, we may undertake the treatment with a view to promote the growth of the extremity, and to accomplish, likewise, a perfect cure of the deformity.

If, therefore, a case of equinus is presented with a paralysis of the flexors, we should at once enter upon the treatment of the paralysis according to the general rules previously suggested. Next, we should provide the foot with an apparatus, in which the action of the flexor muscles is substituted by elastic bands sufficiently strong to balance the extensors. Such an apparatus you see before you (Fig. 14). It consists in a strong shoe, with an iron sole. From the latter, braces arise on either side of the leg, and extend to the knee-joint. At the ankle there are joints which should easily move, and exactly correspond with the axis of motion of the articulation. These braces have two bands, one below the knee-joint and one above the ankle, to fasten around the leg. At the anterior part of the sole an iron arch should be movably fastened over the foot, and a similar one at the upper portion of the brace. Between the two a piece of India-rubber should be so fastened as to flex the foot. This apparatus will suffice for a mild case. But when the resistance of the extensor muscles is considerable, the heel will leave its place, and thereby defeat the object. In order to prevent this, a leather strap across the instep to keep the heel down was formerly em-

ployed. This is a very improper arrangement; for it is both inefficient, and interferes with the circulation to such an extent as to become unbearable. In order to obviate the latter inconvenience, and render the action effective, I have constructed a double screw on the principle of the tourniquet, Fig. 15, which fastens by leather straps to horizontal side-pieces affixed to the brace below the ankle-joint. I look upon this contrivance as exceedingly useful, and almost indispensable in most forms of talipes, because it does away with the rising of the heel, with the interference in the circulation, and may be profitably employed for permanent pressure upon the dorsum of the foot, with a view of diminishing the plantar arch. The lower plate of this contrivance should be well padded, and the pressure to be exercised should be regulated so as not to become excessive. If the skin becomes red by the pressure, it should be shifted to another place to obviate excoriation. This apparatus is, in my humble opinion, the best that has been hitherto constructed.

FIG. 14.

FIG. 15.

In the active form of talipes equinus, in which you have to deal with active contractions of the extensor muscles, the treatment is to be initiated by tenotomy. The operation is the more effective the earlier it is performed. I have had cases under my charge which have been so completely relieved by the section of the Achillis tendon that, after years, not the slightest trace of the previous deformity could be perceived, the limb having grown as its fellow. If the triceps be alone contracted, the Achillis tendon should be divided at a place from three-

fourths of an inch to an inch and a quarter above its insertion—the exact place in accordance with the length of the tendon.

If all the extensor muscles be contracted, the entire group should be divided at the same time. It will be recollected that the tibialis posticus muscle is located immediately behind the internal angle and the malleolus of the tibia; that its tendon at the latter lies in a groove, surrounded by a sheath, and covered in by the aponeurosis of the leg. On account of this anatomical relation, it is somewhat difficult to get the tendon upon the knife. In order to divide it successfully, we proceed as follows: About an inch or a little more above the internal malleolus, we insert a sharp-pointed tenotome through the skin and aponeurosis close to the internal angle of the tibia, and by inclining the handle we longitudinally enlarge the opening through the aponeurosis. After having withdrawn the knife, we introduce into the wound a blunt-pointed tenotome. We keep it near to the bone, and push it between the tendon and the latter. During this part of the operation, the foot is to be left in its original malposition. Having become convinced that the knife has arrived at a proper depth, and the tendon successfully placed upon it, we direct our assistant to flex and abduct the foot; and while this is done, the cutting edge of the knife is turned toward the tendon and the latter divided. The grating, its sudden cessation, and the yielding of the foot toward abduction, are the evidences of a successful division. Otherwise we have to make the operation complete by renewed attempts at catching the rest of the tendon.. The posterior tibial artery lies very rarely near the place chosen for the operation, and there is no great danger of wounding this vessel. Graduated compression against the tibia will meet the exigency, if the artery be cut.

The anatomical location of the two posterior peronei muscles alongside of and behind the fibula, is somewhat similar to that of the tibialis posticus; but their tendons are much more accessible, and therefore more easily to be divided. In reference to the after-treatment, I have little to add. The instrument just described will suffice.

The complications of talipes equinus which occasionally present themselves are, contractions of the extensor longus pollicis, tibialis anticus, and peroneus tertius. The first is the more

usual complication, mostly requiring the division of the corresponding tendon. The most accessible places for reaching the tendon by the operation are in front of the ankle-joint, where it lies between the tibialis anticus and the long extensor of the toes, and next behind the capitulum of the first metatarsal bone; no peculiar difficulties attending the operation at either place. I refer to the general directions of tenotomy.

If the tibialis anticus be contracted, the foot is more or less inverted thereby, and the deformity is thus produced which is known by the appellation of talipes equino-varus. In such a case, the tibialis anticus is likewise to be divided. The tendon of this muscle descends nearest to the internal malleolus, and can be rendered tense by eversion of the foot. The operation itself is performed immediately below and in front of the ankle-joint, and requires no special direction.

Fig. 16.

The most satisfactory results have been accomplished in first dividing the tibialis muscle and reducing the distortion to the simple form of equinus. I affix to the outside of the leg and foot a straight and well-padded splint, by means of which I draw the foot over to the outer side. In this position I keep it until it has lost all disposition to inversion, and then I proceed with the division of the extensor muscles. During the after-treatment of equino-varus, Scarpa's shoe, as improved by Stromeyer (Fig. 16), should be worn by the patient, and in these lighter cases it will be found beneficial. This apparatus may be greatly improved by combining it with the elastic straps and my double screw for the dorsum of the foot. The latter is the more indispensable if the plantar arch be found abnormally increased.

The contraction of the peroneus tertius will evert the foot and present thereby the complicated form of talipes equino-valgus, more or less with the attributes of flat-foot. Inasmuch as we have to devote our attention more especially to this subject hereafter, I beg leave to reserve my opinion at this place, only remarking that the modification in the treatment can be readily inferred.

In fine, if a case of simple equinus be disqualified for operation for reasons already assigned, and should need an apparatus for concealment, it may be well to acquaint you with a mechanical device. Procure a wedge-shaped piece of cork, of sufficient thick-

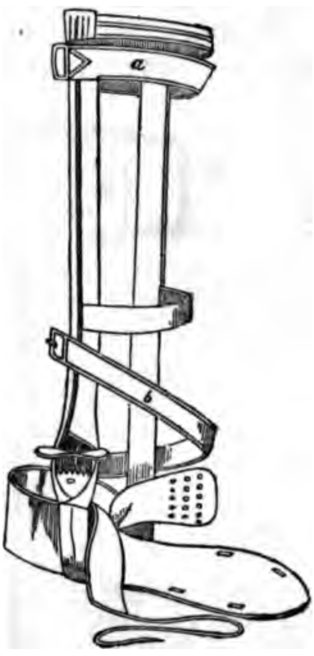

FIG. 17.

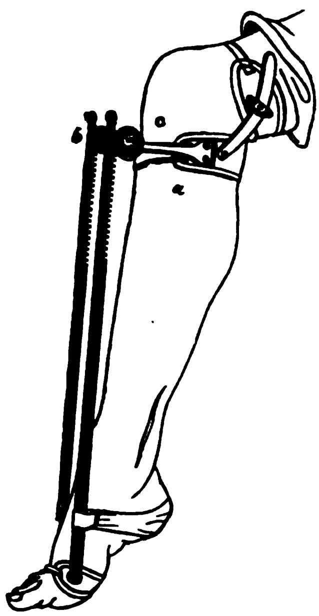

FIG. 18.

ness behind to fill the distance between the heel and the floor; over this have the measure of the foot taken, and a boot made that has to receive the cork inside, or it may be worked in as a part of the sole. This furnishes a boot which is not so unsightly as the deformity, and with which the patient is enabled to walk with ease and facility.

The mechanical boot of Scontelten (Fig. 17), and the apparatus of Delpech (Fig. 18), are entirely out of use, and for them a mere historical interest is claimed.

II.

Talipes Varus.—Equino-Varus.

In this deformity we have to deal with:

1. Contraction of one or both tibialis muscles.
2. Contraction of the triceps muscle.
3. Contraction of those plantar muscles which originate or insert into the plantar aponeurosis.
4. Contractions of either the extensor or flexor muscles of the toes; and occasionally with—
5. Malformation and malposition of the individual tarsal bones, particularly in aggravated and in protracted cases.

Before entering upon the treatment of talipes varus, I will first discuss the important question as to the proper time to commence it. Inasmuch as by far the larger proportion of varus is of congenital nature, it is consequently noticed immediately after birth. It will be well to test at once the pathological character of the deformity. If the latter should prove to be simple malposition of the foot, and simply caused by the previous position in utero (Cruveilhier), it will be well to reduce it forthwith, and to keep it adjusted in a proper position for some days. Plaster-of-Paris bandage, or leather or gutta-percha splints, as Post uses, are to be so moulded to the extremity as to embrace both sides of the leg and foot.

If, however, the cause of club-foot be found to consist in muscular contractions, the application of splints would be futile. Tenotomy alone can give relief. The proper time to perform that operation is at the end of the first year, when the principal part of teething has passed, and the patient evinces some disposition to stand and walk. Locomotion and standing upon the deformed foot being both favorable to the malformation of the tarsal bones, and therefore highly prejudicial, should not be permitted under any circumstances whatsoever.

When proceeding with the operation, the general state of

health of the child should be good, otherwise the wound might suppurate and thereby peril the final result. The operative treatment of varus should be divided into two parts. At first, the contracted tibialis muscles should be divided, and thereby the varus reduced to equinus, in the manner already indicated. This treatment should be persisted in until the tendency of the foot to inversion is, in great part, overcome. This is still more necessary in varus than in equino-varus, and the result is always satisfactory if this part of the treatment has been extended over a sufficiently long period. Next, the Achillis tendon and the plantar fascia with its contracted muscles should be simultaneously divided, because the flexion of the foot and the extension of the plantar arch may be combined by the same mechanical agents. Whether the tendons of the contracted toes may be likewise divided at that or at any later time, is of little consequence. Most usually an undue flexion of the toes is relieved by the plantar section.

Having thus accomplished the relief of the entire contractions, the manipulations and mechanical treatment fairly commence. I exhibit in this diagram the clumsy apparatus used by Stromeyer (Fig. 19), which is still employed by some surgeons. I

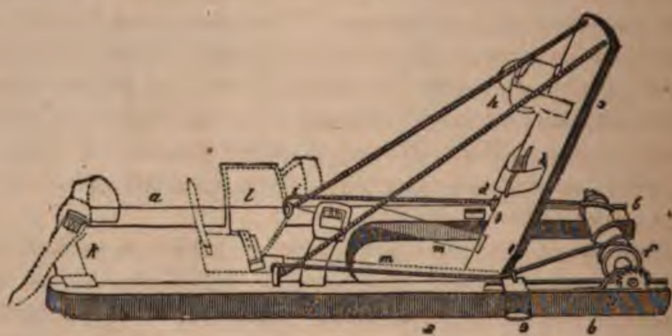

FIG. 19.

cannot advocate its application (although it has pretty nearly all the actions of a good apparatus), for the reason that it is too heavy, that it allows of no fine regulations, and that it obliges the patient to remain in the recumbent posture. In infants who are to be carried about, it is absolutely impracticable, because

too cumbersome. Stromeyer's improvement of Scarpa's shoe is likewise inefficient. The second boot of Scarpa, in which the front part of the sole can be turned and regulated by a screw, is somewhat better, yet its action does not comply with all the indications in the mechanical treatment of varus. In using the latter apparatus the whole leg is turned; but the malformation of the foot is scarcely influenced. In fact, among all the existing apparatus for club-foot, there is none that combines all the mechanical actions required. Dr. Ross's, of Altona, is comparatively the best, and its construction clearly indicates that the inventor has thoroughly penetrated the mechanical difficulties in varus; yet it is still imperfect, and deprives the patient of locomotion.

Although I have never attached the same importance to mechanical means as some surgeons have done, and substituted the hand whenever practicable; yet if, from necessity, we have to resort to their use, it is obviously desirable to procure the most effective construction. Practically convinced of the imperfections of most apparatus heretofore employed in the mechanical treatment of club-foot, I have, for years, persevered in improvements, until I succeeded in constructing an apparatus which, I feel persuaded, answers all the detailed indications.

FIG. 20.

I wish, however, to be distinctly understood that I lay no claim to originality; for I have made liberal use of the preëxisting apparatus, and more especially I have adopted the pad-construction of Ross. My merits, if there are any in the premises, resolve themselves into the practicable combination of the single advantages of others in a small compass, in which the details are most direct and effective, while the whole apparatus is no encumbrance to locomotion. In exhibiting the same, Figs. 20, 21, I will explain my construction, and render you familiar with its use.

The chief feature of my apparatus lies in the construction of the part designed for the foot, and the greatest attention should be paid to its proper fit.

For this purpose I take a moderately short piece of paste-board, place it under the sole of the club-foot, and draw its contours with a pencil, allowing, however, some space for padding, and changes in width and length of the foot, to be gained by the treatment. Next we should mark the places which correspond with the ball of the large toe, and the most prominent protrusion of the external margin of the foot, where pads are to be put in action.

FIG. 21.

According to that pattern, the sole of the apparatus is made of stout sheet-iron, covered inside with buckskin or stout felt, and outside with moderately thick sole-leather, both being fastened through the iron by copper rivets. To obtain abduction, it may be practicable to make the front part of the sole turn by a screw on a rivet, as in Stromeyer's improvement of Scarpa's shoe.

At the ball of the great toe there should be an upright fixture, to lean against when part of the sole itself is movably made. If the sole is continuous, however, there ought to be a movable pad, to push the anterior part of the foot to the other side. A similar fixture, or a movable pad, should be placed opposite the most prominent portion of the fibular margin of the foot. The heel-piece is always a fixture, as in the Scarpa-Stromeyer apparatus. All these parts of the shoe must be well and softly lined. Supposing, then, the foot-part alone is being applied and everything put in operation, you will observe that the foot is acted on in three different directions—namely, at the inner aspect of the heel, at the great toe, and the protrusion of the cuboid bone. Between these three points the foot is stretched, and its lateral infraction is being remedied.

In advanced or obstinate cases of talipes varus and varus equinus, I use the orthopædic shoe alone, and for so long a time until the foot itself is completely changed in form and its tarsal bones are driven back into normal relations. If the dorsum of the

foot is unusually arched, the dorsal screw ought to be put in operation at once, so as to fasten the shoe to the foot and to break down the dorsal arch. Of course, if you are driven to this exigency, you have previously to divide the plantar impediments. By so doing you obtain a fourth—that is, a vertical action. The power of these contrivances is great enough to crush the foot, and therefore should be used with discretion. For, if you allow the patient to keep the shoe on night and day with all bearable force, you would soon have excoriation and slough at the places whereupon its action is centred. Against so undesirable a consequence you have to guard by coverings of adhesive plaster, by pieces of flannel, and by suspending the use of the shoe until the discoloration has disappeared. In the mean while the hand must be freely used, that no time is lost to follow up the results of tenotomy. There is certainly no objection, if the patient or the nurse had a hand in the after-treatment. They soon learn the manipulations from the surgeon, and can materially assist in bringing about the desirable results.

If thus the foot has assumed a better form and relation, the foot-piece is then riveted to the leg-brace, as in the apparatus for talipes equinus. The elastic strap which I recommended in that, to flex the foot, may be also employed in this apparatus, but it is rarely sufficient; therefore screws are to be employed at the ankle-joint to bend the foot. In fine, the leg-brace should be extended beyond the knee-joint and connected with a brace for the thigh, for the purpose of controlling the actions of the knee.

If it should be found that the whole extremity inverts at the hip-joint, which is but exceptionally the case, the apparatus should extend up to that joint and connect with a belt around the pelvis, with a view of turning the extremity in the opposite direction.

In this construction we lose the rotation of the foot as effected by the Scarpa-Stromeyer shoe; but it is impossible to combine this action with the others, and likewise attain a substantial and steadily-acting contrivance. The rotatory movements must therefore be made by the hand.

In light and pliable cases of talipes varus and equino-varus no instrument is requisite, the hand of the surgeon and of the mother being sufficient to reduce the foot to shape and position.

But in high-graded dislocations of this kind, mechanical and manual actions should be kept up incessantly.

You will be astonished to hear that by an uninterrupted treatment of three years I at last succeeded to restore the foot of a farming laborer (*vide* Fig. 13), twenty-seven years old when he came under my charge. And furthermore, that I achieved *material improvements both in shape and position* in the club-foot of a young gentleman from Canada, who had already been operated on three times and undergone the treatment by mechanical means for years in succession without benefit whatever. The liberal use of manipulation, partly with the help of anæsthetics, came in for the greater share in the final results. This treatment is still continued, with the well-founded hope of still greater benefit.

Since the delivery of the lectures on talipes, I have become acquainted with the peculiar views of Prof. Pancoast, of Philadelphia, on this subject, and have had personal opportunity of witnessing their practical application. Although not as yet prepared to offer an opinion as to their correctness, they certainly command the highest consideration. That distinguished surgeon is of the opinion that in talipes equinus and equino-varus, etc., not the entire triceps is contracted, but the soleus muscle exclusively. He therefore contents himself with cutting off the insertion of that muscle from the lower portion of the gastrocnemius and the upper part of the Achillis tendon, and assures me that for the last ten years he had not divided the Achillis tendon itself. On a recent visit to Philadelphia, Prof. Pancoast had the goodness to perform the operation upon two patients for my especial benefit, and gave me the opportunity of assisting him in both cases. I was thus enabled to examine the patients before the operation, with and without anæsthetics, and also to observe the immediate effects of the division. Both cases belonged to the incipient forms of equino-varus, and were congenital. One patient was one year, and the other three years old. On forcibly flexing the foot, I expected to render the entire triceps tense. This was, however, not the case. The belly of the gastrocnemius remained flaccid, whereas the soleus was evidently hard, tense, and resisting. This condition suffered no alteration under anæsthesia. During the operation I distinctly perceived the yielding of the malposi-

tion, and as soon as the last fibres had been divided, the foot could be flexed without great effort.

The operation was performed in a masterly manner, as follows: The leg being placed on its outer aspect and kept limber, the operator grasped the belly of the gastrocnemius and raised it off from the soleus. He then introduced a sharp-pointed tenotome through the skin and aponeurosis. In the wound was inserted Bouvier's blunt-pointed convex tenotome, so deeply as to be felt on the other side between the gastrocnemius and soleus muscles. At this moment the soleus was rendered tense by strong flexion of the foot; and with a horizontal section, the insertion of the soleus was carefully and completely severed. The foot was at once secured in a simple but efficacious apparatus, in which flexion was effected by a screw traversing the ankle-joint of the brace.

I was forcibly struck with the ingenuity of the operation, but must withhold my opinion as to its general applicability. That in the above cases the soleus was exclusively implicated in the malposition, no reasonable doubt could be entertained. I am not prepared, however, to admit or deny the opinion of Dr. Pancoast in the generality of cases, until further experience shall give me an opportunity of thoroughly testing it.

The literature on the subject of talipes varus is replete with views and suggestions contradictory to each other and in opposition to daily observation. The most prominent ones I shall subject to critical examination.

Thus, Malgaigne asserts that in congenital talipes varus no improvement whatever can be relied on after the eighteenth year is passed. This proposition can find but a conditional acceptance. The curability of this distortion depends not so much on the age as on the malformation and malposition of the individual tarsal bones, and the rigidity of their ligamentous connections. In answer to Malgaigne, I need but repeat that while I completely relieved a man of twenty-seven years, I accomplished but little change in the same deformity in a girl twelve years old.

As a general thing, that form of varus is more susceptible to improvement in which the extension of the foot preponderates.

Next, it is held by some surgeons that the relief of talipes

varus is at best but imperfect, and that its subsequent form, position, and usefulness cannot cope with its fellow. I honestly believe that most cases of talipes varus, say eighty per cent., can be *perfectly* restored at an early age of the patient. If the treatment is deferred to a later period of life, the arrest of growth and development must necessarily detract from the result. But of course all must depend on the maxims with which the treatment is carried on. If the surgeon contents himself with tenotomy, and the application of Scarpa's orthopædic boot, he will accomplish but very little for his patient.

The treatment of this deformity requires more than that, in order to lead to satisfactory results. I can exhibit cases to you which are almost perfect in point of form, position, and usefulness; but of course I have assiduously labored to bring about that result for months and years.

A surgeon who has not the will or the time for his patient, has no right whatever to take such cases. Failure is sure to follow, and unfortunately the case becomes aggravated by each of such failures.

Some authors advise to secure at once the improved form of the foot after tenotomy. This advice is certainly unnecessary, and rather prejudicial. The repair does not commence before the fifth or sixth day, and the soft union of the tendinous fragments does not show itself before the twelfth. Moreover, the forcible reduction invites the entrance of air into the fresh wound, which should be obviated.

Of late, the employment of plaster-of-Paris in the treatment of club-foot has been strongly recommended as most beneficial. There could be no better material to secure to the foot a stationary position, and for that purpose it would certainly exceed the orthopædic boot in serviceability. But this is no therapeutic object in talipes varus.

The very contrary is indicated; for we have to keep the limb and foot accessible to daily manipulations, and the use of Faradayism, lubrications, douche, etc., without which the treatment cannot be carried to a satisfactory end. Whatever mechanical means we resort to, to keep the foot in a desirable position, they ought to allow frequent removal and easy replacement.

Relapses in club-foot have been complained of by some surgeons. I fully comprehend the possibility of relapse; but I see, likewise, the errors which lead to it.

The most enthusiastic advocates of plaster-of-Paris inform us that, however perfectly the foot may have been restored, it remains stiff and unwieldy. And if the patient is permitted to walk, it soon turns round again, and shows a disposition to return to its old malposition and deformity. The reason may lie in the foot itself, the respective joints not moving with facility on each other, or the knee or hip joint, singly or collectively, may permit a scope of inversion, which is highly prejudicial to the curative results obtained, and which must be counteracted by appropriate mechanical appliances. I have met with relapses of this very kind, which were, however, speedily corrected.

III.

TALIPES VALGUS.

This species of deformity represents either:

1. Complete paralysis of all the muscles of the leg and foot; or,

2. Complete paralysis, with exclusive contraction of the peroneus muscles; or,

3. Paralysis of the adductor muscles, with antagonistic retraction of the abductors of the foot; or,

4. Reflex contraction of the peroneus muscles; or,

5. Morbid relaxation of the muscles of the leg and of the ligamentous apparatus of the tibio-tarsal and intertarsal articulations; a species of valgus which, in contradistinction to the true form, has been termed talipes planus (Busch).

The treatment of the first variety is obvious, and coincides with the treatment of paralysis in general.

If the palsy of the limb originates in the spinal cord, the iliopsoas muscles are often exempt; and if so, we are able to improve the gait of the patient by availing ourselves of their assistance. For this purpose an apparatus should be so constructed as to convert the entire limb into a stiff pole, joining it at the hip to a pelvic spring. Such an apparatus consists of two slender

steel braces attached to a laced boot, and transversely strengthened by two bands for the leg and the same for the thigh. There is no joint at the knee or ankle. If the extremity is already shortened by arrest of growth, there should be an appropriate heel and sole to the boot. The inner brace should terminate in a crutch, upon which the tuber ischii is to rest. The limb thus secured will partly swing, partly be moved by the ilio-psoas muscle. Locomotion will thus be possible with the aid of a cane, and crutches may be dispensed with. This is the only assistance which orthopædia can render.

The second variety is essentially the same as the former, except that the contraction of the peroneus muscles is superadded. And of the latter we have to dispose before we can come to the aid of the patient by mechanical means. Serious objections have been raised against the division of paralytic muscular contractions, but without tenable ground. I have no objection to attempts being made to relax so contracted muscles, by either the uninterrupted galvanic current in which electro-therapeutists repose so much confidence, or by elastic extension, or other appropriate means. I can but say that I have never been successful in bringing about the relaxation except by the tenotome. And before this is accomplished, we cannot assist the locomotion of the patient by mechanical means; for every step upon the ground will rotate the foot and increase the unsightly deformity.

The third variety has but a local importance, and its therapeutical management is comparatively easy; for you are able to give a proper position to the foot by the hand, and keep it by mechanical appliances. The stiffened bandages will answer the purpose. Scarpa's shoe is however preferable, inasmuch as it leaves the leg accessible to local treatment by Faradayism, etc. But the leg-spring should be fastened to the inside of the boot, so as to act in an opposite direction to that in talipes varus.

In the fourth variety, we have to deal with a contraction of the abductor muscles, excited through inflammation of the tibio-tarsal or intertarsal articulations, which you cannot relieve without resorting to the tenotome. I will not dwell on this topic now, inasmuch as the subject will be reintroduced in connection with joint diseases; but this much I may be permitted to say, that the contraction of the peroneus muscles, inducing talipes valgus,

is as much apt to produce inflammation of those joints, as the latter eventuates in contraction of those muscles and talipes valgus.

In times past, and before these pathological relations were fully understood, many an amputation was performed which the proper use of the tenotome might have obviated. Nay, even at the present time, cases come under my observation of protracted articular diseases of that locality which I am successfully, and I might say instantaneously, relieving by promptly dividing the contracted peroneus muscles. It is indeed the only and sovereign remedy.

In the last variety, which is mostly of congenital origin, and frequently associated with and occasionally the consequence of knock-knee, we have neither to deal with paralysis nor with contractions; but what seems to be a mere relaxation or looseness of the ankle and tarsal joints. It is known by the popular term of weak ankle. As the consequence of knock-knee, the abnormal position of the foot is produced by the constant strain upon the internal ligaments of the ankle and intertarsal joints, which of course can but be relieved by correcting the malposition of the knee-joint.

In idiopathic talipes valgus there are two curative indications; first to correct the malposition, and next to re-establish the natural arching of the foot. The first is to be responded to by Scarpa's shoe, with the same modification which I have indicated. Better, however, would be a snugly-fitting laced boot, to which Scarpa's spring is attached.

To meet the second indication, we have to force the sole of the foot to bend over an appropriate bracing, by either cork wedges or a steel spring fastened inside the sole of the boot. Such springs are in common use for ladies' gaiters; but the spring ought to be well fitted to the sole, and best moulded to a cast of plaster-of-Paris previously taken. From time to time the arch of the spring should be increased so as to adapt itself to the changed condition of the foot. Similar changes should be observed with reference to the cork wedges. Busch recommends the use of splint and cork wedge for the night, fastened by bandages to the foot.

The treatment of talipes valgus coincident to rachitic bends

of the tibia, falls together with the treatment of the latter, and will be referred to in the appropriate connection.

IV.

TALIPES CALCANEUS.

The therapeutic suggestions for the management of calcaneus I have chiefly derived from other authors, since I have had no case under my charge. Little, Brodhurst, and others coincide in the necessity of dividing the tibialis and peroneus tertius; and, if necessary, the two remaining flexors of the foot, extensor pollicis longus and digitorum communis longus. The foot should then be forcibly extended and kept in extension by splints; meanwhile, frequent passive motions should be made in the ankle-joint, and the after-treatment followed up with the boot used in equinus, with this difference, that the elastic band should be fastened to the heel and the leg-band, to act in the place of the paralyzed triceps suralis. If the elastic band should suffice to keep the foot rectangularly to the leg, the section of the flexor should of course be dispensed with.

V.

TALIPES PLANTARIS

Requires for its alleviation the section of the contracted plantar muscles, including the plantar aponeurosis, an iron boot, with vertical pressure upon the dorsum of the foot by my double screw. This plan will stretch the foot and diminish the plantar arch. With this treatment we have even succeeded in a case of eighteen years' standing.

VI.

ABNORMAL ABDUCTION OF THE GREAT TOE

Necessitates the division of both the tendons of flexors, extensors, and abductor muscles of the large toe; a triangular cushion between the first and second toe, or the use of a wooden splint along the sole, with a vertical well-padded fixture to drive

the large toe into adduction. In obstinate cases, and in cases of long standing, complicated with partial or total dislocation, exarticulation seems to be the only resort.

VII.

BURNS IN THE NEIGHBORHOOD OF THE ANKLE-JOINT

May have caused contraction of the skin and malposition of the foot. In such a case, gradual and persistent extension in the opposite direction will most usually overcome the contraction; and, according to the case, one of the orthopædic apparatus which I have suggested for the treatment of the various kinds of talipes may be employed. The subcutaneous loosening or plastic operations are rarely required.

CHAPTER IV.

SPINAL DEFORMITIES.

General observation on the anatomy of the spinal column.

GENTLEMEN:—The spinal column is, both in an anatomical and mechanical point of view, a wonderful construction. In adults it consists of twenty-four single bones (vertebræ), united in a continuous column by twenty-three intervertebral fibro-cartilages. These endow the spine with a high degree of flexibility, constrained, however, by the shape of the vertebræ and their strong ligamentous apparatus. The intervertebral disks, being very elastic and increasing in thickness toward the base of the spinal column, are eminently qualified to break the violence of mechanical influences. In this the cartilages are greatly aided by the natural curves which the spine of a full-grown man presents. Prof. Weber* has most accurately ascertained the physiological deviation of the spine from the perpendicular. After having prepared the subjects by removing the thoracic and abdominal organs, and filling the cavities with a solution of plaster-of-Paris, he divided the spinal column with the plaster mould longitudinally, and by this process preserved its correct position. The result of the measurement may be briefly stated as follows: Atlas and centre of sacro-vertebral articulation conform with the perpendicular. The centres of the second and third cervical and fourth and fifth lumbar vertebræ slightly project from the perpendicular, whereas the rest recede. The greatest tension of the curve lies at the sixth and seventh thoracic vertebræ, whose distance from the perpendicular amounts to 2·750″. The first and last thoracic vertebræ occupy the same position to the perpendicular—namely, 1·400″. From these researches it is obvious that, when viewed in the profile, the spinal column presents three curves—two small ones anteriorly at its cervical and lumbar por-

* Mechanik der menschlichen Gewerkzeuge. Göttingen, 1836.

tion and a large posterior one. Rollin and Magendie have asserted that the threefold curves of the spine increased its mechanical strength sixteen times. But this is certainly an error, and against all mechanical laws. On the contrary, the curves obviously weaken its physical strength, and the most powerful musculature is necessary to sustain its firmness in the erect posture. The curves, on the other hand, render the spine more endurable to violence that may bear upon it from above or by contre-coup, which would certainly crush a straight one. Besides, space is thus provided for the suspension and protection of vital organs. The oval form of the vertebral bodies subserves the same mechanical purposes as the round form, yet leaves more space in front and behind. The cancellated structure is likewise better adapted to the vertebral bodies, being lighter and less frail than the compact osseous substance, though the latter would bear more weight.

E. H. Weber* has acquainted us with the relative part the vertebræ or cartilages have in the formation of the spinal curves.

The table on the following page exhibits the proportionate thickness of either. The first column states the number of the vertebra and intervertebral cartilage; the second, the middle size of the vertebra; the third, middle thickness of the cartilage; the fourth, the difference between the anterior and posterior height of the vertebra; the fifth, the same difference of the intervertebral cartilages; the sixth, in fine, the middle diameter of the latter. The + and — indicate excess and deficiency.

In comparing the results of the fourth and fifth columns, I find that at no part of the spine are the anterior and posterior height of the vertebral or intervertebral cartilages the same, and that the difference in their thickness is the cause of the respective curves. It is also evident that the cervical and lumbar curves are chiefly formed by the cartilages, whereas the thoracic curve depends mainly on the form of the respective vertebræ themselves.

Although the elasticity of the intervertebral cartilages is great, yet it does not entirely accord with the elasticity of unorganized substances. Thus, for instance, the cartilages do not possess the power to resume their full height after compression. Hence

* Merkel's Archiv, 1827.

the body, in the erect posture, loses about one inch in the course of one day, and requires the horizontal posture for six to eight hours to regain its full height.

This physical condition of the intervertebral substance is no doubt operative in the establishment of distortion of the spine.

In the preceding remarks, I have dealt with the spine of adults; but its anatomico-mechanical structure in infants and children differs widely from that of adults. The ossification of

1		2	3	4	5	6
CERVICAL.	1	0·00	0·00	0·0	0·0	0·0
	2	31·50	2·70	+3·0	+0·6	14·7
	3	13·20	3·55	+0·8	+0·1	14·9
	4	13·05	2·65	—0·1	+1·3	14·2
	5	13·10	3·75	—0·6	+1·5	15·1
	6	12·00	4·60	—1·0	+1·2	15·9
	7	13·00	3·45	—0·8	+0·1	15·2
		95·85	20·70	+1·3	+7·8	
DORSAL.	1	16·80		—1·0	—0·8	17·0
	2	18·60	3·40			19·8
	3	18·50	3·15	—0·0	—1·3	21·3
	4	19·20	2·40	—2·0	—1·2	21·9
	5	19·85	1·90	—1·9	—1·8	26·4
	6	19·40	2·15	—2·0	—0·7	27·5
	7	19·50	3·10	—2·4	—1·4	28·5
	8	20·45	3·15	—1·5	—1·3	27·8
	9	20·45	4·30	+0·3	—1·2	28·0
	10	23·20	3·20	—0·6	—1·2	28·8
	11	23·20	2·50	—1·4	—0·6	
	12	23·80	5·65	—1·0	+0·7	
		242·95	34·90	—13·3		
LUMBAR.	1	26·50	4·70		+2·0	27·9
	2	28·15	4·85	—0·8	+2·1	29·1
	3	28·15	6·90	—1·1		29·1
	4	26·75	6·85	+0·7	+2·2	29·3
	5	26·30	8·65	+1·7	+3·3	29·5
				+6·2	+2·3	27·7
			10·90		+9·2	
		135·95	42·85	+6·7	+21·1	

the spine in the embryo appears later than in almost any other bone of the skeleton; the anatomical perfection requires likewise more time, and exceeds the period of puberty by years. During all that time some parts of the vertebræ are connected with the bodies by cartilages, and, consequently, they are much more easily disconnected by traumatic causes than if the vertebræ were entire. This anatomical status renders the spine as a whole much more flexible than that of adults. In fine, there are *no physiological curves in the spine of infants*, and they develop themselves very slowly, so that they are scarcely established to their full extent at puberty. This should be borne in mind, because it accounts for the greater susceptibility to spinal deformities in childhood.

To all appearance the spine is a mechanical apparatus of great physical strength, and certainly well calculated to fulfil the offices which nature has designed for it. By constant physical training, its mobility may not only be increased, but greatly extended beyond the ordinary anatomical limits, which can be observed in the feats of gymnasts. Not every spine can bear, however, such distortions without injury, and it would seem that they are much more easily produced than has been hitherto supposed. The experiments of the late Professor Bonnet, of Lyons, render this almost conclusive. He succeeded in producing upon the spine and its components, with comparative little physical violence, any injury, from the rupture of ligaments and muscles to dislocation and fracture of the vertebræ. In the spine of children this would be much more easy than in adults, to which the experiments of Bonnet seemed to have been restricted. Nor can there be any doubt that fractures of the spine occur more frequently during life than is generally believed; for the Museum of the Royal College of Surgeons, England, the Musée Dupuytren, and other private collections, contain specimens to that effect. In some of them the diagnosis was made ten or more years after the accident, and in some post mortem.*

* Beiträge zur Vergleichen der Anatomie der Gelenkkrankheiten von Dr. Gurlt Berlin, 1853.

I.

ANTERO-POSTERIOR CURVATURE.—KYPHOSIS.—GIBBUS.—MALUM POTTII.

Historical.—Pott's and Delpech's theories on causation.—Susceptibilities of the spinal column to mechanical derangements and fractures.—Bonnet's experiments.—Cases.—Constitutional and traumatic causes.—Prognosis.

This deformity was not only known to Hippocrates, but its cause definitely attributed to tubercle "within and without the lungs." Galen employed the same term. Guillot and Nélaton are of the opinion that the pathological knowledge of tuberculosis can be distinctly traced to the ancients. However this may be, it is sure that Marcus Aurelius Severin introduced the term "tubercle" in the seventeenth century, with a rather loose meaning, and Delpech gave to it its present pathological currency.

The authors who, during the seventeenth and eighteenth centuries, investigated the pathology of kyphosis, as Bonnet, Ruysh, Cooper, Pott, promulgated the idea that caries of the spine was the invariable cause of the malady; and Delpech gave it the finishing touch, in demonstrating that the caries originated in tubercular disease. This opinion met with general acceptance, and prevails to this very day. In Nichet and Nélaton it found its warmest advocates.

Delpech lays down two modes of tubercular invasion. There is either a central deposit which grows by juxtaposition, gradually rarefying and destroying the cancellated structure of the vertebral body, until it is physically disqualified to bear the superincumbent weight. It breaks consequently down, and suddenly gives rise to a posterior curvature of the spine. Or the tubercular substance is deposited under the periosteum, anteriorly or laterally to the vertebral bodies, gradually excavating them until the destruction of the bone has been accomplished to the opposite wall, when the spine gives way and bends either posteriorly or laterally, as the case may be.

Nichet and Nélaton advert to a third mode, namely, *a general diffusion or infiltration of tubercular substance throughout the entire*

cancellated structure, with subsequent rarefaction of the latter or the formation of a sequestrum. The intervertebral disks are but exceptional recipients of tubercular deposits (Nichet).

Between the views of Pott on one side, and those of Delpech, Nichet, and Nélaton on the other, there is no clashing. One stands to the other in the relation as cause to effect. Kyphosis is, according to those authors, a posterior, mostly angular curvature, initiated by tuberculosis of the spinal bodies, followed by carious destruction of their cancellated structure; the deformity being as it were but the mechanical consequence of a symptom.

With very few exceptions, the foregoing opinions seem to have been adopted without question or dispute by all modern writers.

Bonnet led off in opposition to those pathological views in stating that, with due deference to the meritorious researches of Nichet and Nélaton, their conclusions had certainly been received with too great readiness and too little reservation; that equally reliable observations had been entirely ignored by them. He, for one, knew positively that causes other than tubercular deposits were prone to give birth to posterior curvature. But even Bonnet could not raise himself above the fashion of his day, and had to concede to tuberculosis a considerable share in the causation. Cruveilhier, Bilroth, Gurlt, and particularly Virchow, have taken firm ground against the tubercular theory of causation, and have certainly so far succeeded as to lessen the self-assurance of its advocates.

Inasmuch as I intend to devote some time to the discussion of this very important question in connection with the consideration of articular diseases, I must forego the present opportunity, and refer you to that portion of my lecture.

With what flippant levity the followers of the tubercular theory of causation manufacture facts to perpetuate their pathological errors, and with what an indifference they lay themselves open to critical castigations, the following case may serve as an example.*

Mr. Gore, one of the surgeons to the United Hospital of Bath, admitted on the 5th of April, 1865, the patient Eliza E——, aged sixteen years, of fair and florid complexion, rather healthy appear-

* London Lancet. 1865.

ance, and not emaciated. The very first symptom of an affection of the cervical portion of the spine had presented itself but five weeks previously. She died on the 6th of May, after an illness of about two months. The report of the autopsy states that the brain was quite healthy; the spinal cord in the lower cervical region was put backwards and pressed against the vertebral arches by an extensive *tubercular deposit* external to the dura mater. This part of the spinal cord was soft and pulpy for about two inches; lower down it appeared somewhat shrunken and wasted. There was no great vascularity of the surface, and no effusion of serum. The periosteum covering the posterior surface of the bodies of the fourth, fifth, sixth, and seventh cervical, and of the first dorsal vertebræ, was more or less destroyed and detached, leaving the surface of the bones bare, white, and rough. Between the fifth and sixth cervical vertebræ the intervertebral substance was almost completely destroyed, and a passage in this way established to the front of the spine, where there was an abscess behind the pleura, containing about six ounces of *scrofulous matter*. She had no disease of the lungs. The kidneys, unfortunately, were not examined. In conclusion, Mr. Gore benefits the reader with his diagnosis of very acute tuberculosis.

Who can read the records of the author without a contemptuous smile? Mr. Gore considers his case so conclusive that he does not even go to the trouble to trace congenital tuberculosis to the ancestry of the patient, nor does he deem it at all necessary to subject the *tubercular matter* he found to the microscope. I have never met hitherto a more conclusive exposé of spinal periostitis, and I entertain no doubt whatever that the "tubercular matter" of Mr. Gore was simple pus, contaminated with some detritus of bone, cartilage, and periosteum.

How easily the most competent judges may be misled by preconceived pathological views, is clearly evinced by the following:

1. *Case of Kyphosis of more than six years' standing, complicated with motor paralysis of lower extremities.—Relief of the latter and arrest of the disease for a period of four years.—Death from granular meningitis.—Interesting pathological disclosures (vide title-plate).*— At the tender age of two years and nine months the patient met with a fall. A short time after the accident the little girl

exhibited some indefinite indisposition, inducing the parents to call upon Prof. Willard Parker. There were as yet no indications of an impending spinal trouble, nevertheless that sagacious surgeon rendered a clear diagnosis. Deriving, however, no encouragement from him as to the ultimate recovery of their offspring, the parents subsequently placed the child under the charge of Prof. Valentine Mott, who directed the ordinary treatment then in vogue, rather encouraging than disparaging locomotion. Among other remedies resorted to, issues close to the spine were established. For five months the treatment was scrupulously carried out, whilst the malady was steadily advancing. At last the treatment was suspended, and for ten months nothing was done to arrest or mitigate the affliction. Meanwhile the suffering of the patient had become unbearable, the deformity had greatly increased, and the locomotive power of the lower extremities so much impeded, that the parents again sought professional aid.

At this juncture I took charge of the case. The patient was then prostrate, attenuated, and almost hydræmic. She was moderately feverish; cardiac action greatly excited; her respiration laborious, and her temper irritable. The angular deformity occupied the thoracico-lumbar portion of the spine, the first lumbar spinous process being the most prominent point. There was great tenderness about the spine, and such perfect motor paralysis of the lower half of the body that no stimulus excited the slightest reflex action. No traces of abscess could, however, be found in either lumbar or ilio-inguinal regions.

The early appearance of the deformity after the accident, its seat, rapid progress, and angular shape, left scarcely any doubt as to the cause of the trouble, namely, fracture in the body of either the twelfth thoracic or first lumbar vertebra. Under this impression the prognosis was certainly unfavorable, for all symptoms indicated structural and form-alterations of some vertebral bodies. Caries was at least impending, if it had not already commenced; new complications were thus threatening, irrespective of the already existing paraplegia. In fine, the constitutional force of the patient had already been broken down. There were consequently no prospects of recovery; even the arrest of the disease was more than problematical.

Nevertheless, whatever might be the eventual results of the treatment, the actual sufferings of the patient demanded some palliatives. Horizontal posture upon a water-bed, moderate local depletion, inunctions with ung. hydrargyri, and of course generous diet, were insisted on and readily complied with.

I should not have been surprised to see the patient somewhat relieved by this treatment; but my expectation was greatly exceeded both by the rapidity and extent of her improvement, so much so indeed, that I became sceptical of my diagnosis. The ameliorations at the end of the eighth month may be briefly summed up as follows: regularity of all vital functions, excellent appetite and rest, satisfactory appearance, increased weight (by five pounds), entire immunity from pain, locomotion of lower extremities almost reëstablished to perfection.

During this period I had already applied the spinal splint, allowed the patient to creep about on knees and elbows, and to be taken into the open air. At the end of the same, presuming that a most *unexpected consolidation* of the spine had been achieved, I ordered a spinal supporter closely fitting to the cast then taken, and suffered the patient to take cautious and moderate exercises, frequently interrupted by rest in the recumbent posture. The first attempts of this description were however so satisfactory in their bearing, that very soon I removed all restrictions, and allowed the child to do whatever she pleased.

Four years the patient was thus doing well. Although I frequently saw the patient, yet I had no occasion to call upon her professionally again until last spring, when she had suddenly been taken sick. Without enlarging on the details of her late illness, suffice it to say that she suffered from, and eventually died of, meningitis cerebralis exudativa.

Fortunately, the enlightened parents felt with me the same interest in the character of the case, and therefore readily consented to the autopsy, which was made twenty-four hours after death.

The general appearance of the body, especially the state of her nutrition, was satisfactory, considering that she had just passed through a course of sickness during which but little food had been taken. There was intense arachnitis, with

widely scattered granular eminences, made up however of connective tissue; the disease did not extend into the spinal canal, though the brain and cervical portion of the spinal cord were in a state of hyperæmia. Thorough search for tubercular deposits in other organs ended in a negative result. That fragment of the spine concerned in the disease having been removed and longitudinally divided, disclosed, indeed, a pathological condition which I was not prepared to find.

The specimen (A. B.) consists of the six inferior thoracic, the second and third lumbar vertebræ, besides fragments of the first four lumbar ones. To the left half of the specimen the corresponding portion of the spinal cord is still attached. (1.) The angular infraction of the spine locates exactly at the remnant of the first lumbar vertebra. On raising the cord it may be noticed that the bend of the spine leaves the spinal canal free from any encroachment or obstruction whatever. Nor is any morbid change presented by either the cord or its membranes.

Anteriorly and laterally the lower portion of the specimen is surrounded by a large complement of firm connective tissue (2), obviously restraining the otherwise inevitable mobility of the infracted spine. The adjacent soft parts show no indication whatever of suppuration. Whilst with one exception all intervertebral fibro-cartilages are completely healthy, the body of the first lumbar vertebra is almost totally, and that of the twelfth thoracic partially, destroyed; and the remaining ones exhibit more or less large cavities (3) filled with a yellow semi-solid material. All these cavities are located close to the dura mater (4), and in some that membrane supplies the posterior wall of the same. Whether the cancellated structure of the vertebral bodies had slightly suffered from osteoporosis I am uncertain; that of the twelfth dorsal was rather densified from plastic infiltration. In the fresh state a moderate hyperæmia of the spine could be clearly discerned.

As has been mentioned, two of the vertebral bodies had substantially suffered in both shape and size. Of the body of the first lumbar vertebra, but a posterior fragment (5) has remained, and even from this a smaller piece (6) has become so completely detached that it can be taken out of its crummy bed and replaced. Anteriorly to the fragment a tolerably large cavity (7) exists, which I found filled with a similar material as the cavities of the

bodies. Of the body of the twelfth thoracic vertebra but a small fragment is missing; its form has then become deficient in a diagonal direction (8), as if a small wedge had been chipped off from the anterior and lower portion. Exceedingly interesting is the relation between the remnants of the two bodies. The lower surface of the upper vertebra rests upon the anterior of the lower in almost a right angle. But it would seem as if the upper surface of the first lumbar vertebra had inclined forward and downward, in which case the cancellated structure must have previously caved in. Between the two the intervertebral disk is completely destroyed.

Gentlemen, you may readily imagine that I felt the most intense solicitude to get at the real nature and composition of that yellow semi-solid material that filled the osseous caverns. At the first glance it presented itself as tubercular deposit *par excellence*, and this very appearance made me still more tenacious in ferreting out its character. Whilst I engaged in the microscopic examination of one, I sent the other half of the specimen to a gentleman in New York, whose profound knowledge in pathological anatomy and dexterity in the use of the microscope has perhaps no superior in this country. To prevent misunderstanding, I accompanied the specimen with a note, setting forth that I requested his opinion as an expert on the question, Whether that material was tubercle or changed pus?

Great, indeed, was my discomfiture when that gentleman sent an answer to the effect "that it needed no microscope to recognize the tubercular material of the specimen."

In spite of my deference for his opinion, I nevertheless continued my own investigation, which resulted in a widely different conclusion. The subject being, however, of too great importance to rely on my observation exclusively, I requested Prof. Alonzo Clark to lend his assistance, which he courteously granted. In an examination of more than an hour, instituted with that care and circumspection which so eminently distinguishes that gentleman, the fact was indisputably established *that the material in question was bonâ fide pus in a state of condensation and fatty degeneration.*

Another question at once grows out of that decision—namely, *how are the multilocular abscesses in the vertebral bodies to be ac-*

counted for? The answer is much easier than might be imagined. For all the abscesses are placed in close proximity to the spinal dura mater; some of them open upon it. Subjacent to that membrane, and along the anterior wall of the spinal canal, a similar material can be traced, which connects, as it were, the abscesses all along the spine. I infer therefore that the purulent material, in the place of any other outlet, expanded up and downward between the dura mater and the anterior wall of the osseous spinal canal, causing the multilocular abscess, and eventually undergoing all the changes simultaneously with their contents. This would seem the only explanation admissible.

During the suppurative process the quantity of pus that raised the dura mater from the spine, the spinal cord must have been compressed or have suffered from irritation, and hence the paraplegia. Thus the pathology of the case seems clear and plausible. Yet other points need mention.

In the first place, was I right in presuming a fracture as the cause of the deformity? After a due deliberation of all circumstances attending the case, I cannot be induced to change the previous diagnosis. For the existing mischief is by no means incompatible with the same, irrespective to the arguments already set forth. I have repeatedly stated in my lectures that the thoracico-lumbar region of the spine is very susceptible to fracture, and that a wedge-shaped fragment may be easily chipped off in front and below a vertebral body. This has been demonstrated by experiments and autopsies. If the fracture is disregarded, and the patient continues locomotion, the fragment is displaced anteriorly, and the spine bent backward. The former may or may not become agglutinated in the new position. In the latter case it may be turned into a sequestrum, and thus give rise, like every other foreign body, to local irritation, suppuration, caries of the adjacent bony structures, and in fine lead to exactly the very same consequences with which we had to grapple *in concreto.*

Next, which of the vertebral bodies had been fractured? In glancing at the specimen, it will be found that the twelfth thoracic one exhibits exactly the form in which the ordinary fracture would leave it; that is to say, the body is defective to the extent of a small wedge removed anteriorly and inferiorly.

Caries of the fractured surface may have slightly increased the defect, but the type is still visible. The greater destruction of the first lumbar vertebral body may be thus accounted for, that the bony fragment remained in connection with the lower fibro-cartilage; that therefore the irritation arising from that source was more readily transmitted to the structures to which it was attached, and that in fine the matter would more readily descend than ascend. Thus the body of the lumbar vertebra had been macerated in pus, and eventually disintegrated. There is likewise a possibility that the fracture extended at once through both implicated vertebral bodies down to the subjacent fibro-cartilage. If we elongate the line from the face of the twelve thoracic vertebræ through the first lumbar, it would terminate at least 2‴ from the spinal canal. Such a supposition is, however, scarcely tenable, since the posterior curvature must have been instantaneous and at once considerable.

Again, it seems singular that suppuration to that extent, provoked and maintained by foreign bodies, as it were, should have existed without external manifestation, and moreover should have come to a stand-still spontaneously, for a period of four years.

Facts like these do not often present themselves in the ordinary range of surgical observation, but they go far to shake the old theories. Even the advocates of bone tubercle, like Rokitansky, Lebert, and others, are forced to admit that the so-called bone tubercle proves often to be pus, having undergone some organic changes.

No clinical observer can deny the fact that diseases of the spinal column spontaneously originate. I have myself seen a few cases of this description to which I shall specially allude. Neither can it be disputed that by far the larger number of antero-posterior curvatures are engendered by traumatic injuries directly inflicted. As in articular diseases, most cases of that description occur during childhood. Recent affections of the spine, terminating in kyphosis, are of the rarest occurrence among adults. Why tuberculosis of the bone in infancy should preponderate is the less to be comprehended, as the disease in general appertains much more to adult age. This is certainly a contradiction of all clinical experience, which can find its solution only in diagnostic errors.

We know that the infantile spine is much more subject to mechanical derangement, from the fact that each individual vertebra is composed of seven different pieces. The experiments of Bonnet and Pellissier render the fragility not only of the spine, but certain portions of it, still more demonstrative. It is chiefly the thoracico-lumbar portion of the spinal column where fractures are experimentally produced; and it is by no means surprising, therefore, why posterior curvatures, and especially the angular variety, are more frequently observed at that particular locality.

It is not often, however, that opportunities offer for conclusive autopsies. The morbid process is mostly advanced beyond the possibility of ascertaining the original and proximate cause. But once in a while cases present themselves which leave no doubt as to the pre-existence of fracture. A few clinical cases of this kind may be in place.

2. *Case of fracture of the body of the fifth dorsal vertebra.—Instantaneous protrusion of the corresponding spinous process.—Formation of abscess at the seat of fracture.—Bursting of the same into the left pleural cavity.—Left-sided empyema.—Death.*—A weakly child, aged four years, fell with her back on the sidewalk. I saw her about half an hour after the accident, and noticed the prominence and tilting up of the fifth thoracic spinous process. There was but little pain attending. I diagnosed fracture, and advised rest in the recumbent posture, with immobilization of the spine. The parents did not share my apprehensions, and could scarcely be prevailed upon to accept my plan of treatment. During the ensuing fortnight the patient was kept in bed, and whilst thus prevented from locomotion the child felt perfectly well, had no fever, and complained of no pain. Persuading themselves that the prominence of the fifth thoracic vertebra had been there before the fall, and looking upon my views as over-anxious, the parents thenceforth suspended all restrictions, and allowed the child to play about. At that juncture I saw the child in the street, and took again occasion to warn the family of the impending danger, but to no purpose. I had thus to give up the case. In about six weeks from the date of injury, I was urgently requested to see the same child. Finding the patient with

excessive fever, dulness over the left side of the chest, and panting for breath, I could have no hesitation in connecting the condition of the left pleura with the fracture and the formation of an abscess, the latter having discharged its contents into the left pleural cavity. Merely for the purpose of defying and defeating my diagnosis, permisson was granted me to make a post-mortem examination.

The appearances fully affirmed the views I had taken of the case. *There was a fracture of very little extent of the fifth thoracic vertebra.* A wedge-shaped fragment was chipped off the anterior and inferior portion of the body, with its base connected with the next intervertebral cartilage below. The piece was still covered in part by the anterior ligament of the spine. There was evidently a sliding of the vertebra upon its lower cartilage, which thus caused the spinous process to project and tilt. At the seat of fracture there was an abscess, consisting in two compartments on either side, communicating with each other through the fracture. The left one had opened in the left pleural cavity, and had given rise to purulent pleuritis.

The fracture was so insignificant, and so located, that it might have united without trouble, had sufficient time and rest been allowed. The deformity could scarcely have been obviated, being the direct and inevitable consequence of the physical derangement of the spine on one hand, and the superincumbent weight of the body on the other. Even a moderate increase of the original deformity would not have been inconsistent with the healing process of the spine, by the necessary softening of the vertebra and its adjacent cartilages.

If anything, this case clearly proves the great susceptibility of the spine to injuries, and it furnishes one of the corroborative facts to the experimentative results of Bonnet. The fall indeed must have been but light; and, considering the protection of the spine by the clothing of the child, there was not even the slightest contusion at the place of injury.

3. *Case of caries and abscess of the spine.—Asthma Millari.—Death.—Autopsy.*—The little patient was but three years and nine months old when she was brought to my office. Her father is suffering from phthisis. Her mother is a strong and

stout woman; and the children are of unexceptionable good health. The little girl had likewise enjoyed a robust constitution up to about four months previous to my seeing her, when she met with a fall from a chair in such a manner as to force the head violently forward and downward upon the chest. From that time she had suffered severe pain at the neck, become much attenuated, and experienced constitutional perturbations. On examination, the cervical portion of the spine was found to incline, and the head to be rolled backward. At the cervico-thoracic portion of the spine there was a marked prominence of several spinous processes, of which that of the first dorsal projected farthest. Whilst thus carefully proceeding with the examination, the patient was suddenly attacked with so great an occlusion of the rima glottidis as to render her breathless, cyanotic, and slightly convulsed. The attack lasted at least fifteen seconds, and gave rise to serious apprehensions of instantaneous death. The examination had of course to be discontinued, but sufficient clinical facts had been elicited to form a diagnostic estimate of the trouble. I gave my opinion then and there that there had been a fracture, if not a comminution of one, probably of the first dorsal vertebra. The injury, having been disregarded, has given rise to inflammation and suppuration, and probably superinduced the formation of abscess at the seat of fracture, encroaching upon the œsophagus and the recurrent nerve or nerves. Hence the paroxysms of Millar's asthma. The prognosis could be rendered but as extremely unfavorable, and I distinctly stated that the child would not survive many of those attacks.

Four days after the reception of the case, the death of the child was reported to me in exactly the same manner as expected. Fortunately the autopsy was permitted. An abscess in front of the spine was found commencing at the fourth cervical, and terminating at the fourth dorsal vertebra. The subperiosteal pus had raised the periosteum from the subjacent spine, and encroached materially upon the œsophagus, but I had no time to ascertain its minute relations to the recurrent nerves. The diseased portion of the spine being removed, consisting of a fragment of the seventh cervical and the upper three thoracic vertebræ, exhibited a destruction of the bodies of the last cervical and first dorsal vertebræ; and so completely that but the arches remain,

still protected with the intermediate cartilaginous disks, by means of which they join the bodies. There is of course an undue mobility at the place.

The first and second rib on either side have lost their vertebral articulations. But a small sequestrum remains, obviously part of the seventh cervical vertebra. The dura mater is exposed to the action of pus. The latter is rather thin, but bears all the characteristics of the purulent fluid, mixed however with osseous detritus.

The rapid destruction of the vertebral bodies in so short a time, scarcely a vestige being left, is a matter of great pathological interest. Hardly less interesting than this is the question of causation. There appeared to be nothing in the child indicative of a morbid diathesis. The patient was substantially well when she met with the injury. Her troubles commenced then and there. The fall, moreover, was well calculated to break or crush the cancellated tissue of the vertebral bodies, for she stood upon a chair, leaning against the wall, and whilst the former started, she glided downward with her head, and actually fell with her head between the wall and the chair; the head doubling upon the breast. There consequently can be no doubt as to the local and specifically traumatic origin of the lesion, notwithstanding the extensive disintegration of the bones concerned.

4. *Case of fracture of spine and sternum.—Paresis of lower extremities.—Retention of urine.—Subsequent thoraco-lumbar kyphosis.—Final recovery.*

My esteemed friend Dr. John Cooper, of this city, introduced to the clinic Lawrence Gordon, fifty years of age, a carman by occupation, with the following history:

On the third of July, 1862, the patient drove his vehicle, heavily laden with wood, on a sloping ground. The elevation was firm, the slope soft, and one of the wheels cut deeply into the soil. Gordon exerted all his strength to balance the vehicle, by pressing with both hands against the lower standing wheel. Nevertheless the cart turned over to his side, first bending his body violently forward; and at last, when he had to give way, he was thrown on his back, with the load and the cart upon him. On being extricated, a fracture of his sternum was dis-

covered, about an inch below the manubrium. The case was deemed a serious one, and therefore sent to one of our public hospitals. Besides the symptoms incidental to the before-named fracture, he experienced much pain in the lower part of his back; volition of lower extremity was moderately impeded, and he could not void his urine, on account of which the catheter had to be employed from the very start, and during the succeeding ten days, when this symptom gradually subsided.

From the statement of the patient, it appears that the trouble in his back did not excite the apprehension of his surgeon, nor was it thought to be in any way connected with the retention of urine. At the end of a fortnight, the chest symptoms having subsided, he was induced to rise, but could not keep himself upon his legs. It was his impression that the attending surgeon doubted the reality of his inability to move; a carriage was ordered, and the patient sent home. He most positively assured me that while in the hospital his spine was never examined. *Relata refero.*

Being introduced to the clinic on the fifth of September, the patient presented the following condition: Good and powerful frame, but general attenuation—more marked, however, about the hips and in the lower extremities. His gait is peculiar to spinal affection, his spine being kept perfectly stiff; shoulder-blades retracted, and head slightly reclined. Walks with bent knees (to obviate concussion of the spine). No fever; appetite and rest good, although temporarily disturbed by circular pains around the waist, particularly after a day of exertion.

The sternum is firmly united, the lower fragment slightly overlapping the superior. There is no impediment in respiration.

The lower portion of the spine is very tender on pressure, but still more so on percussion. The twelfth thoracic, and first, second, and third lumbar vertebræ protrude posteriorly, forming a gentle curve, in which the second lumbar vertebra occupies the most prominent position. The superincumbent portion of the spine is antero-flexed. Locomotion is tolerably easy, though the patient has to move with bent knees, in order to obviate painful jarring of the spine. There is still some slight trouble in the

discharge of the urine, and the sexual functions have been entirely suspended.

The patient averred that up to date his spine had not been examined, and therefore learned for the first time that his spine had become deformed. How soon the deformity made its appearance after the accident cannot be precisely ascertained; but, judging from the degree it had attained when examined on the fifth instant, but two months after the accident, it may be reasonably inferred that the deformity was the immediate result of the injury, and has ever since and steadily increased, in consequence of the patient having walked in the erect posture.

There can be no reasonable doubt that the accident caused a fracture of the second lumbar vertebra. I infer this from the position in which the patient resisted the upsetting of the cart, and which concentrated both his exertion and the weight of the loaded cart upon the thoracico-lumbar portion of the spine, unduly flexing the same, and from the early appearance of its deformity. Most probably a wedge-formed fragment has been chipped off the body of the second lumbar vertebra right in front. A mere contusion or sprain of the spine, or laceration of ligaments and muscles, could not have given rise to so early a curvature. Dislocation of the lumbar vertebra without fracture or diastasis is impossible. The seat of the fracture and its limited extent render the non-interference with the spinal cord compatible.

The permanent suspension of the sexual functions is easily accounted for by the seat of the fracture, and the descent of the spermatic plexus in front of the same; whereas the temporary impediment in the voiding of urine must be traced to the incidental extravasation of blood sinking down in the cellular tissue toward the hypogastric and sacral plexus, from whence the bladder derives its nervous endowments. It is much to be regretted that the diagnosis was not made at an earlier period, when rest and the recumbent posture for some months would have sufficed to obviate the deformity, and the inflammation which ensued.

This case speaks volumes in regard to the causation of posterior curvature, and I hope its record will tend to weaken the confidence in its presumed pathology.

The patient was advised to suspend labor entirely, and to

keep in bed. Local appliances of an appropriate character were resorted to. When last I saw the patient in the street he seemed to be free from complaint, and expressed himself contented with the result of the treatment.

It seems, indeed, unnecessary to resort to hypothetical means in order to understand the pathology of the malady. The vertebral bodies are, like the cancellated structure in general, highly vascular, and therefore susceptible to inflammation. This process in the bones, and its pathological results, are at present well understood. There is not one solitary symptom or morbid change connected with the so-called Pott's disease that could not be brought in accordance with ostitis and its phases. Thus, for instance, a vertebral body may be softened down by inflammatory effusion or fatty metamorphosis, may change its form through the superincumbent weight, give rise to a gibbus of greater or lesser size, and then the disease may be arrested without proceeding to the formation of an abscess; or purulent infiltration and caries may ensue. These pathological views would bring it at once within the scope of our comprehension, why contusions and kindred injuries of the spine in the healthiest children gradually give rise to posterior curvatures, for which we have analogy in other spongy bones.

But I am inclined to think that true spondylitis, or better, spinal Osteomyelitis, is no frequent disease, and that the disintegration of the vertebral bodies is more often induced by injuries to the spine directly applied and interfering with their continuity. Comminutions and fractures are certainly more common than has heretofore been supposed, and diastasis of subordinate parts is likely to happen.

I am led to this supposition by clinical facts of so unequivocal character as to allow no other interpretation. Besides, the undeniable curative results of rest, recumbency, and exclusively local appliances, are as conclusive evidence for diagnosis as if the mechanical lesion had been demonstrated upon the dissecting-table.

Not all primary affections of the spine are confined to its bony structure. Some start in the appendages, the intervertebral cartilages, the periosteum, etc., in which the bones may eventually be compromised.

Heretofore it has been treated as an open pathological ques-

tion whether the intervertebral fibro-cartilages could become the seat of primary lesion, and it must be admitted that but few pathological facts have been produced in proof of the latter. The indifferent morbid susceptibilities of cartilaginous structure are fully established by experiments. But it seems that the fibro-cartilages of the spine, by virtue of their direct mode of maintenance and vascularity, are endowed with a comparatively higher degree of vitality, and consequently subject to morbid invasion. Considering, therefore, that the elasticity of the spine exclusively, and its flexibility, in a great measure depend on the cartilages, it is very evident that any undue tax of either must inevitably infringe upon their status and lead to structural changes. Quite a number of posterior curvatures having come under my observation, moderate in symptoms and size, and of a rounder form of deviation, my suspicion had long before been excited with reference to the fibro-cartilages. But the opportunities for post-mortem examinations were so rare in this species of curvature, that up to the year 1854 I was left in doubt whether my suspicion had any foundation in point of fact.

FIG. 22.

Case 5. Softening of the intervertebral fibro-cartilages, with consecutive caries.—Death from Bright's Disease.—Autopsy. In that year Dr. Lewis A. Sayre consulted me in the case of a young man who had during the preceding eighteen months suffered from disease of the spine and lumbar abscesses. The patient was twenty-one years of age, about six feet in height, greatly attenuated and anæmic. What attracted most my attention was the perfect straightness of the spine, of which the plaster cast now exhibited, Fig. 22, is a correct copy. The patient soon after died in uræmic convulsions induced by Bright's disease, and the pathology of the case underwent a thorough investi-

gation, in which Prof. Alonzo Clark rendered his valuable assistance.

The specimen before you, gentlemen, very remotely exhibits the condition observed when recent.* It consists of the lower portion of the spine, from the fifth thoracic vertebra downward. There were large cavities between the psoas and quadratus muscles, communicating internally with some small carious excavations of the spine, and externally with the sores on the back. In its passage the matter had corroded the left transverse process of the third lumbar vertebra. This specimen was perfectly straight when removed, and its present bend has been caused by the mode of its preservation. The first striking appearance in the recent specimen was the unusual thickness of the fibro-cartilages, their exuberant protrusion from between the vertebræ, and their entire loss of elasticity. By a moderate longitudinal pressure the bones were almost brought into contact, and had to be pulled asunder. There was but little difference in this respect among the different disks. While being pressed, a fatty, whitish detritus came forth, which under the microscope exhibited fragments of the structure, spindle-shaped cells containing granules, and fat globules in abundance.

The spine itself, longitudinally divided, presented *no tubercular deposit* and but moderate hyperæmia.

On the opposite surfaces of the second and third lumbar vertebræ there were two superficial excavations, corresponding in seat; a little larger in the third, with a loose sequestrum. Between these vertebræ the cartilage was almost entirely destroyed, the anterior lamina only being left. On the inferior surface of the fourth thoracic vertebra there was likewise a central carious excavation, of small size, and surrounded by that dense osseous tissue which, you recollect, passes by the appellation of sclerosis or eburnated structure. In the specimen it can still be seen, the cartilage protruding and filling the said cavity.

Now you notice that in the specimen before you there are but four carious places, namely—at the fourth thoracic, second and third lumbar vertebral bodies, and the left transverse process of third lumbar vertebra; whereas the rest of the vertebræ are perfectly sound. But one intervertebral cartilage (between the

* Vide Letter C. of title-plate.

second and third lumbar vertebræ) has been destroyed, while the others have not lost in substance; on the contrary, they appear enlarged.

Thus, gentlemen, it is very evident that the caries of the three named vertebræ have not caused the disease of all the intervertebral cartilages, and especially not of those that occupy a seat remote from the respective bone diseases. This would be barely impossible. But is it equally impossible that the disease of the three vertebræ originated in the cartilages? I think not; and for the following reasons:

1st. All the intervertebral cartilages are seriously affected, and have suffered structural changes; whereas but three of the vertebral bones exhibit disease.

2d. The disease of the latter is located at the surfaces which are in close anatomical connection with the intervertebral cartilages.

3d. The disease of the osseous structure is evidently proceeding from the periphery toward the centre, taking the sclerotic tissue in proof.

4th. Comparing the morbid condition in cartilages with that of the vertebræ, and bearing in mind, what Toynbee has observed, that the former disintegrate with less rapidity than the latter, it must be conceded that the pathological changes are not only more extended, but also further advanced in the cartilages than in the bone.

I feel therefore justified in inferring that in this specimen there is primitive disease of the fibro-cartilages, with consecutive caries of the fourth thoracic, second and third lumbar vertebræ. Nor can it be doubted that the disease consists in inflammation. The absence of the ordinary inflammatory products is by no means incompatible with this diagnosis, in as far as the modus of nutrition would necessarily modify the inflammatory process. This view is moreover strengthened by the cause of the malady, namely, over-exertion and fall.

Permit me, gentlemen, to ask your particular attention to the physical effects of the disease—namely, the *entire loss of elasticity* of the cartilages. The perfect absence of all elasticity accounts readily for the *straight deformity* which the spine presents, having simply been occasioned by the supine posture continued during eighteen months on a hard and even mattress.

Supposing the patient had walked about with this state of his spine, what would have been the result? Unquestionably a posterior deformity! For a spine that yielded its form to comparatively a few pounds of dead weight in the supine posture, would have equally yielded to the greater superincumbent weight in the erect posture.

This point is of invaluable practical importance for the treatment of posterior curvature; and I am not aware that it has by any precious record been put in the same high relief.

Under the same species of spinal affection probably belongs the curvature of the spine which is the result of whooping-cough. It occupies invariably the thoracic portion of the spine, and forms comparatively a gentle curve of more or less tension. There is but little pain observed, either in motion or percussion; abscesses very rarely emanate from these cases.

Among the appendages of the spine we have next to consider the periosteum as the seat of primary disease of the spine. Spinal periostitis is not frequently observed, and it shows itself more in adults than in children. I have seen it but twice among the latter. One patient was nine years, the other fourteen years old.

The cause of spinal periostitis is mostly obscure, and generally ascribed to rheumatic influences. In but one instance syphilis was clearly established as the exciting cause; and inasmuch as the case yielded to the antisyphilitic treatment, the diagnosis admits of no doubt. The history of the case may speak for itself.

6. *Case of Syphilitic Spinal Periostitis, with Consecutive Posterior Curvature.* The patient, a German merchant, was forty-five years of age when attacked by gibbus. He had been three years affected, when, in consultation with two prominent practitioners of New York, I saw him.

His deformity comprised most of the thoracic vertebræ, and simply presented a larger curve than the normal one. The symptoms attending his case were quite insignificant. The pain was but trifling, the respiration almost undisturbed, and his rest was scarcely affected. Notwithstanding, the deformity had slowly and steadily increased, and was quite formidable when I was called in; up to that time the patient had followed his business

avocation, had walked to his office down town, and scarcely felt any diminution of muscular power.

Besides his deformity, he presented some extensive gammatous swellings at the tibia and other cylindrical bones, occasional soreness of the palate, and increased discharge from the nostrils. On change of weather he experienced pain at the swelled bones, but he was free from pain in good weather. For some twelve years he had been treated for chronic rheumatism, and repeatedly used the decoction of Zittman, besides other remedies.

His physicians had set the case down as caries of the vertebral bodies without suppuration, had repeatedly applied the moxa, actual cautery, and the like remedial agents, but the patient had derived no benefit whatsoever from them.

On a close examination into the antecedents of our patient, I made out a different diagnosis. With some reluctance the patient admitted to have been affected with chancre as early as 1830; had undergone a treatment with calomel under the least auspicious hygienic circumstances. The disease had returned in less than a year, when, under his own reponsibility, he had the treatment repeated. During the subsequent ten years he had variously suffered from syphilitic symptoms, and been variously treated for them. The affections of his bones were of an early date, but they had been kept in submission by medicines, and never allowed to extend.

In the absence of any other plausible cause of the deformity, no alternative was left but to ascribe it to the effects of syphilis, for which there were, indeed, positive proofs.

That syphilis may invest the vertebræ has been conclusively demonstrated by Colles, although it is conceded to be of rare occurrence. In the present case there were no signs of a structural affection of the vertebræ, no disintegration of the surrounding soft tissues, neither abscess nor fistulous openings denoting caries.

My opinion was then, and is still, that the syphilitic virus had affected the periosteum of the spine, and that gammatous deposits had formed as upon cylindrical and flat bones; and, in fine, that gradually the intervertebral fibro-cartilages had been compromised. That the latter are not exempt from syphilis is beyond dispute.

Of course I advised rigorous antisyphilitic treatment; from

all I have learned since (1854), I have good reason to believe that the patient was greatly benefited, and his deformity brought to a stand-still.

It is not often that periostitis gives rise to curvature, and never directly. Subperiosteal suppuration is, however, inseparable from superficial caries. The latter may, indeed, proceed, and gradually destroy the vertebral bodies to so great an extent as to be utterly disqualified to sustain the superstructure of the body; or, as we have seen in the case just related, involve the intervertebral fibro-cartilages, and thus lead indirectly to spinal deviations; but that much seems evident, that periostitis, *per se*, cannot occasion the latter. I have made five autopsies upon bodies in which death had been caused by pyæmia, originating in suppurative periostitis of the spine. In none of them was there any spinal deviation from the perpendicular.

In advanced and still progressive cases of caries of the spine, it is of course impossible to determine in what structure the trouble had originated. Pathological investigation at that juncture furnishes mostly the same results as in general diseases of articulations. One or more vertebral bodies are totally, others in part, destroyed. Around the diseased portion of the spine, in its immediate neighborhood, there are extensive subperiosteal infiltrations and engorgements which remind of white swelling. Occasionally we meet with attempts at the formation of new bone. The rarefied cancellated structure of the diseased vertebral bodies is filled with pus. The latter has entered the spinal canal and spread up and downward below the spinal dura mater. Sometimes it is condensed to the consistency of soft cheese, with small sequestra embedded. The bony structure is so frail and soft as to admit a probe with readiness. The vertebral arches are crowded backward, and thus relieve the spinal marrow from pressure. The next higher vertebral body leans forward and downward, so as to come in contact with the next lower remaining one. Occasionally the anterior surface of the one rests upon the superior of the other. If the vertebral bodies of the thoracic portion of the spine are destroyed, the ribs lose their base of articulation, and are consequently unduly movable.

With this state of the spine, abscesses are of common occurrence. They do not always terminate on the surface of the body. They

may be walled in, as in one of the cases I related; they may establish communication with the pleural or abdominal cavities, as I have exemplified with one instance, and set up a deadly inflammation of their respective serous linings; they may undergo a retrograde metamorphosis, and leave a yellow, cheese-like, semi-solid substance, which has so often passed as "tubercle *par excellence*," in which, however, the microscope will still disclose the organic elements of pus. Most usually the abscess will gradually work its way toward the surface, and give rise to so-called cold and consecutive abscess. They give but rarely much trouble to the patient; they very frequently form without the knowledge of the latter, and may exist for many months without materially acting upon or changing the condition of the sufferer.

The seat of these consecutive abscesses depends chiefly on the locality of the spinal disease. Thus in ulcerations of the cervical vertebræ the matter follows the course of the longus colli muscles and their respective aponeurosis, raising both off the spine and encroaching upon the posterior wall of the pharynx (post-pharyngeal abscess), or descend along the sterno-mastoid and scaleni muscles, and appear above the first rib and behind the clavicle. But rarely do these abscesses open into the thoracic cavity. If the matter originates at the lower cervical portion of the spine, it may follow the course of the brachial plexus and collect in the axillary cavity. The pus that originates in the dorsal vertebræ collects usually in the posterior mediastinum, following the course of the aorta through the diaphragm, the iliac arteries, and making its appearance at the femoral fossa (Fig. 23). In other instances the matter gets under the fascia of the psoas muscle, and collects in the neighborhood of the small trochanter. Cases are known in which the matter descended into the pelvic cavity and perforated the rectum.

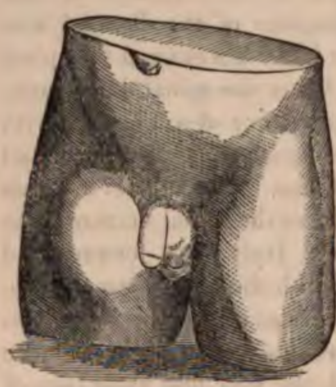

FIG. 23.

The matter from the lumbar vertebræ follows either the course of the aorta and iliac artery, or the direction of the psoas muscle, and accordingly collects either at the femoral ring or near the small trochanter. Sometimes the matter gets into the bursa of the ilio-psoas muscle, and thereby enters the hip-joint (Fig. 24), and *vice versâ*. The history of this very interesting case, and its pathological anatomy, was published by me in the *New York Journal of Medicine*, vol. xii., 1854, to which I beg to refer. The specimen itself was presented by me to Professor Willard Parker. The patient, having suffered for a long time from intermittent fever, which gave rise to enlargement of the spleen and leucæmia, met with *a fall upon his back*. Three weeks after the accident, his spinal trouble made its appearance, in the course of which psoas abscess formed on either side. On the left, it opened directly below Poupart's ligament. On the right there were several fistulous openings at and below the small trochanter, the cause of them being caries from the eleventh thoracic down to the fourth lumbar vertebræ. In its descent, on the right side, the matter had most likely, by means of the ileo-pectineal bursa, entered the hip-joint, and caused great disintegration of its component parts. Besides, the matter had cut across the femur, below the small trochanter, so that the limb was connected with the body only by the muscles.

FIG. 24.

The course of the matter may be toward the back (lumbar abscess), toward both back and femoral fossa, and occupying the intervening iliac fossa.

As to the seat of the deformity, you notice from the diverse specimens, all being taken from life, that no portion of the spine is exempt, though it happens more frequently in one part than another. Thus it is rarest at the cervical, less rare at the lumbar, oftener at the thoracic (Fig. 25), and most frequent at the thoracico-lumbar region of the spinal column (Fig. 26). You will remember that the last is exactly the place where fractures

usually happen, and where injuries take more effect than elsewhere.

I am conscious of not having exhausted either the pathology or the causation of antero-posterior curvature, which would indeed exceed our limited time; but still I feel persuaded that you know all which is of practical bearing and importance.

A few remarks may be deemed in place with reference to the termination of these maladies, which give rise to the kyphosis. They are of so varied a character as not to allow of generalization.

I need not enlarge upon caries of the spine. This is a formidable disease. Many a patient falls the victim of gradual exhaustion and pyæmia. Especial danger arises from ulcera-

Fig. 25.

Fig. 26.

tions of the cervical vertebræ in consequence of the encroach-ments upon the pharynx and larynx and the pneumogastr nerves and their branches. But few patients survive that ma ady. With all, however, recoveries from caries of the spi are by no means rare among them. I have seen some mo desperate and apparently hopeless cases recover, of which t following is in point:

7. *Case of extensive Caries of the Spine.—Lumbar-Iliac Abscess.—Discharge of Numerous Sequestra.—Thoraco-Lumbar Gibbus.—Recovery.* This little patient came under my charge more than three years ago, after having been ailing with what seemed to be general debility and deranged nutrition for not less than six months previously. Without much difficulty I established the diagnosis, and the fact that his trouble had emanated from a fall from a fence, upon his back. Local depletion, recumbent posture, and scrupulous hygiene for some six months, silenced all the prevailing symptoms. At that time I was importuned by the family to allow the patient to resume locomotion. The deformity was then quite insignificant. I ordered a well-fitting spinal brace, and secured rest and position of the spine as well as mechanical means would permit. Moreover, I restricted locomotion to but a few hours in the day, which may however have been exceeded. During this time I watched with anxious solicitude the effects of this premature experiment.

In less than three months symptoms of the old trouble recurred, and induced me to resume the former treatment. During the two following years, the child was scarcely able to leave his bed. A lumbo-psoas abscess formed, and discharged quarts of matter. At least twenty small sequestra were successively eliminated from the fistulous openings. The patient was reduced to a skeleton, and suffered for months from hectic fever. In spite of a water-bed, decubitus set in. And yet this patient has recovered, and is now one of the most active boys in his neighborhood. To be sure, but very few patients in this situation would have escaped, and the life of this one was preserved only by hygienic advantages which but wealth could purchase; nevertheless this case shows the unlimited recuperative resources of beneficent nature.

The local changes that accompany the process of repair in the spine are the same as in other bones. The disorganized portion of the cancellated structure is either thrown off in the form of sequestra, or destroyed by the granulations, as may be so beautifully studied in osteo-myelitis of the cylindrical bones.

New bone is formed, and osteophytic bridges cross the existing hiatus, lending strength and support to the spine. The deformity remains permanent. The diagram (Fig. 27) furnishes

a comprehensive illustration of the ulterior results of caries of the spinal column.

In softening of the intervertebral cartilages, the *restitutio ad integrum* is obviously of a much simpler character, inasmuch as the osseous structure is but exceptionally involved. The cartilages lose in height and elasticity, and become pervaded with

FIG. 27.

more rigid fibrous tissue. Sometimes the vertebral bodies come in direct contact with each other, and lose by use in height. But rarely osteoplasms occur in connection with this lesion.

In periostitis the latter are numerous, and not rarely so massive as to encroach upon the adjacent vessels and organs. In either of these diseases, the spine loses its flexibility.

It is rather strange that the occurrence of traumatic injuries to the spine by falls, twists, contre-coup, etc., has been generally slighted by surgeons, and their influence underrated as the cause of posterior curvature; whereas constitutional causes have been admitted with eager readiness. I can account for this singular disregard of traumatic injuries but in one way, namely, that their consequences *ensue at so late a period as to admit hardly of any causal connection.* And yet analogy and daily experience amply demonstrate that the affections of bones, cartilages, and tendinous structures are extremely tardy in their development, and that between cause and signal morbid effect many months may pass by before the latter presents its gross and noticeable manifestations. Occasionally we may succeed in establishing the links between the two, but more frequently the causes are *forgotten* when their consequences appear. Ever since I have taken a lively interest and paid special attention to orthopædic surgery and the diseases of the bones and joints, I have been forcibly struck with the above fact. I have collected all the clinical material that could possibly elucidate the point, and have found sufficient proofs to maintain that traumatic injuries are *the chief cause* of most of the maladies that befall the structures comprised in the spinal column and the locomotive apparatus. It may seem that I dwell too much on this subject, and repeat too often my views on the same point; but, gentlemen, it is of the utmost importance that the authority of clinical facts should be put in such high relief as to be recognized and respected. Still, the general opinion prevails, that posterior curvature is the concomitant of poverty, gross hygienic neglect, and deteriorated constitutions. My clinical observations do not accord with these sweeping views. In the first place, I have met the difficulty as often, if not more frequently, in high life, although I have had a fair share of dispensary practice. Next, I have found boys more numerously afflicted with gibbus than girls; and, in fine, I have seen the most healthy and robust constitutions invaded where no dyscrasic taint could be discovered without fastidiousness. These observations do not correspond with the generally

received opinion, and rather indicate the preponderance of external causation.

In summing up, I may comprise my views in the following aphorisms:

1. I have traced to mechanical causes *almost all cases* that have come under my clinical observation.

2. The deformity happens much more frequently among boys than girls.

3. The deformity occurs almost exclusively during infancy and its heedless wranglings; consequently at a period when the spine is yet imperfectly developed, consisting of numerous fragments held together by cartilage, and therefore easily deranged.

4. The deformity exempts no social class, and is as frequent a visitor of the wealthy as of the poor, if not more so.

5. Although no portion of the spine is exempt from the deformity, yet that region is most commonly the seat of deviation which, according to Bonnet, is *the chief recipient of injuries*—namely, *the thoraco-lumbar portion.*

6. *The efficacy of the recumbent posture and mechanical contrivances, calculated to secure rest to the spine.*

7. The favorable *results of antiphlogistic, and especially cold appliances.**

8. The *negative* effects of constitutional, and the specific antiscrofulous treatment.

The inquiry into the pathology of posterior curvature is obviously conclusive as to the fact that *the deformity is not the disease itself, but one of its symptoms,* and not without some reasons has Bonnet termed it *secondary dislocation of the spinal column.* The array of specimens in plaster-of-Paris before you demonstrates that—

1. Posterior curvature is not a rare deformity.

2. It may involve any part of the spinal column.

3. It may assume *the form of an angle or of a large curve;* and that

4. It more or less deranges the form of the trunk.

With one exception, all specimens belong to the tender age, from the second to the sixth year of childhood. Before that time you will only exceptionally observe it, and after that it

* Prof. Esmarch in Archiv der Klinischen Chirurgie, B. i. Heft 2. Berlin, 1860.

originates from exceptional causes alone. It seems, therefore, that at that circumscribed period of life the anatomical predisposition rests.

Kyphosis is essentially of *slow growth*, unless in case of fracture and immediate displacement. *Between its remote cause and its final appearance weeks and even months may intervene.* The symptoms attending its development are mostly insidious and of a general nature. The difficulty may even exist for some time without being noticed at all, so little inconvenience may be occasioned thereby. As a general thing, the deformity has existed for some time, has considerably advanced, and has already made some impressions upon the constitution of the patient, when your attention is invited. The apparent absence of all external causation, and the constitutional derangement along with the curvature, have misled so many authors to presume the pre-existence of dyscrasia, or, as it is called, a strumous diathesis. These suppositions are utterly devoid of foundation.

Careful and patient investigation will mostly discern the fallacy.

You will learn that the child has been well, and often rugged, up to a certain period, when it met with a fall upon its back from a fence, a staircase, a table, or a chair, as the case may be; that it had been wrangling with other children, and been thrown upon the ground, or received a blow of some kind upon the back, etc. The cause had at the time attracted no notice, since the patient *did not complain*; had enjoyed afterward and for some time its usual health; and that when it had complained, its troubles had been *so trifling* and *general* that nobody had thought of the fall and the spine.

The phenomena characterizing the primary results of spinal trouble are, as already stated, of a general nature; and it is not without difficulty that we can connect them with their true source.

1. There is a general debility of the child, with indifference to activity.

2. The patient appears sallow, pallid, and anæmic.

3. Its appetite is indifferent, its urine turbid and concentrated (from excess of urate of soda), its bowels irregular, its rest uneasy, and interrupted by frequent moanings.

4. The patient prefers solitude to the company of its playfellows; and, if urged to take a part in their sports, it will soon drop off, lie quietly down, and assign shortness of breath and agitation of the heart as the cause.

5. Where and whenever the patients stand, sit, or listen, they will always manage to procure some sort of support for the back, toward which they lean; and, in want of anything better, will place their arms on a table and push the shoulders up, or support the head by the arms upon the knees. If anything, these positions are of a more decided symptomatic significance for diagnosis.

How long these preliminary symptoms may prevail is very uncertain, depending of course on the slow or rapid advance of the disease itself. This much is sure, that if the direct signs set in soon after the injury, we have a serious lesion to contend with.

Under the essential symptoms of the deformity, *pain, stiffness of the spine, and the protrusion of one or more spinous processes,* occupy the first place.

The pain is very characteristic indeed. It is felt *around and in front of the body,* less at the spine itself, unless excited by percussion, contre-coup, or a sudden twist. At the cervical portion of the spine the patients experience some difficulty in deglutition; at the thoracic portion, the respiration is impeded and becomes laborious. Singultus is a common accompaniment. At the thoracico-lumbar portion the patient complains of pain in the stomach, and, exceptionally, of difficulty in the discharge o[f] urine.

By placing the patient in the prone posture, however, an[d] exploring the spine with *a hot sponge, by percussion,* and *by later[al] movements of the body,* you will find no difficulty in ascertainin[g] the exact seat of pain, and its irradiation through the cervic[al,] intercostal, or lumbar nerves.

The stiffness of the spine is likewise a significant diagnostic ph[e]nomenon, noticeable in the posture, gait, and the movements [of] the patient, in which the spine is concerned. In the erect po[s]ture, and in the gait of the patient, the spine is kept at rest, th[e] head is fixed and slightly drawn backward, while the shoulde[r-] blades are retracted and the thorax pressed forward. *The mov[...]*

ments are very careful, and with the view to obviate the slightest jarring of the spine. The patient seems anxious for support, and will avail himself of everything. He leans forward upon a table, supporting his head by placing the elbows upon the table, and the hands below the lower jaw; or will throw himself across his mother's lap, by flexing the hip-joints, or across a chair; in picking something from the floor, will bend both hip and knee joints, and thus gradually and carefully approach the object, often supporting the body by placing the left hand upon the left knee. The latter movement is, indeed, very characteristic and decisive for diagnosis.

If the deformity has existed for some time, and the patient has been permitted to walk, no diagnostic difficulty exists. You will then find more or less posterior deviation of the spine, with more or less anterior curvature, which has been called *compensating curvature.* Over the kyphosis, the integuments become attenuated, so that the spinous and oblique processes are covered with integuments alone.

In the progress of the deformity, various consecutive effects are produced which deserve mention. Among others there are:

1. *The malformation of the thorax,* which consists of the elevation of the sternum and ribs, whereby its width materially increases, and its length proportionately diminishes.* Whether the mobility of the ribs is simultaneously impeded, is not yet decided; but I am inclined to believe it is.† This deformity of the chest has nothing in common with the so-called *chicken-breast,* the result of rachitis and compression of the ribs from right to left, which happens even without posterior deformity.

2. *General attenuation* of the body, which is mostly of permanent duration, and seemingly dependent on an impediment of vital organs and the great sympathetic nerve.

3. *Paralysis of the lower extremities.* This very frequent complication of antero-posterior curvature is scarcely ever caused by

* Vide Fig. 26.

† Anchylosis of the ribs by osteophytes constitutes, of course, permanent immobility. An undue mobility of ribs from loss of articular base I have never clinically noticed. Not unlikely that their attachment to the transverse process and the sternum prevent it.

the inflexion of the spine. The spinal cord is in such a manner suspended within the spinal canal as to accommodate itself to the varied postures of the body, without being interfered with. The intervertebral foramina are likewise larger than the size of their respective nerves. The numerous examinations of the spine, in cases of lateral and posterior curvature, have rather shown *the spinal canal and intervertebral foramina larger than the safety and protection of the nervous structures require.* But cases have been placed on record, in which abscesses had opened and sequestra had found their way into the spinal canal, giving rise to mechanical impediments. The common cause of paralysis consists in hyperæmia, irritation and inflammation of the membranes, and in some cases of the cord itself. This supposition is borne out by negative and positive clinical facts; for the paralysis very often makes its appearance *in comparatively recent cases,* whereas advanced cases *may be free from it.* At any rate, it seems to be entirely independent of the degree of deformity, and is scarcely ever noticed in lateral curvature, however aggravated. I have observed it, on the other hand, in acute cases of kyphosis, where all the symptoms denoted a high degree of inflammation of the spine and its adjacent structures. Remedies calculated to alleviate the existing active symptoms—as for instance leeches, cold fomentations, and the recumbent posture—most usually relieve paralysis, and I am cognizant of instances in which the latter disappeared in a few days. The paralysis comprises commonly the motor apparatus alone, and scarcely ever involves sensation. The motor fibres, being in the anterior columns of the spinal cord, and nearer to the seat of the disease, are therefore more exposed. On the other hand, I have never observed paralysis in which the active symptoms of disease had entirely disappeared.

4. *Retractions of the flexor muscles of the thigh,* under the same pathological conditions in which paralysis is met with. In some instances this symptom has been mistaken for an affection of the hip-joint, and treated accordingly. There is, however, no difficulty in its differential diagnosis; for the hip-joints are free from pain on pressure and motion, and neither abduction nor adduction is impeded. Moreover, the contraction happens generally in affections of the lumbar portion of the spine, and con-

cerns the psoas and iliacus internus muscles, and is therefore either simple flexion, or flexion with eversion without additional malposition of the thigh.

5. Consecutive abscesses have already been referred to.

Prognosis.—From preceding remarks it must be inferred that posterior curvature is a much more formidable complaint than empirics are capable of realizing, and by no means as intractable as is generally presumed by those practitioners who link it with tuberculosis. The pathological diversity of the complaint renders a sweeping prognosis impracticable and worthless. In fact, each case is to be carefully qualified before a reliable prognostic conclusion can be arrived at.

Recent cases, of course, admit of a better prognosis than advanced ones. Softening of the intervertebral cartilages is of less prognostic importance than periostitis, diastasis, fracture, or osteomyelitis of the vertebral bodies. Of all curvatures, that allows the best prognosis which originates in whooping-cough or syphilis. An arched curvature is less dangerous than an angular one. Whooping-cough, inflammation of the lungs and air-passages, are aggravating complications. Paralysis, in connection with posterior curvature, is indicative of an active morbid process, although itself commonly capable of relief. The same view may be entertained in reference to contractions. The formation of abscess constitutes an advanced disintegration of the component structures of the spine, and therefore may be looked upon as a serious and most unfavorable symptom.

Caries of the cervical vertebræ is much more serious, on account of the danger of implicating the phrenic and pneumogastric nerves, and their respective branches; less dangerous is caries of the thoracic, and least that of the lumbar vertebræ.

In aggravated and extensive ulceration of the spine, the danger of pyæmia and gradual exhaustion is impending.

CHAPTER V.

TREATMENT OF KYPHOSIS.

Prevailing obscurity on the subject.—Rest and position of the spine the first axiom in the treatment.—Horizontal position.—Objections over-ruled.—Its therapeutical advantages.—Local depletion.—Cold fomentation.—Water-bed.—Cuirass.—Braces of questionable value.—Dr. C. F. Taylor's spinal supporter.—Gymnastic exercises in the after-treatment.

In the treatment of no other complaint are the fluctuations of theory more marked than in that of antero-posterior curvature. The adherents of the tubercular theory have had it almost their own way during the last century. They were working upon the vitiated constitution of the patient, and the affected spine was surrendered to the tender mercies of mechanics and quacks. Pathological investigation is of comparatively recent date. Thus it comes that a complaint known to the profession of almost every period, should still be shrouded in obscurity, and that the maxims of its treatment should still be unsettled and subject to differences of opinion. The validity of acknowledged principles in surgery is even questioned in their application to this subject. If a person has broken one of the bones of the lower extremity he is consigned to his bed, and the fractured limb is splinted as a matter of course, simply because the injured bone is disabled from carrying the superstructure of the body. But when the spine is much more seriously injured, softened, and partially destroyed, and surely physically unfit to subserve the erect posture of the body, it is left an open question whether the patient is to be kept on his back or allowed to walk about as usual, supported by a flimsy mechanical contrivance. Nobody cares anything at all whether, in fracture, the constitution suffers from confinement. In kyphosis all solicitude seems to be centred in the general health, and the condition of the spine is almost ignored. I do not indeed understand how the constitution can be improved at all as long as local irritation is permitted to continue—as long as rest and appetite remain disturbed.

It ought to be clearly understood that the antero-posterior curvature of the spine is but a symptom, whereas those morbid conditions claim our therapeutical attention which form its pathological base.

In the preceding part of the discourse, I have endeavored to acquaint you with the varied maladies of the spine which mostly give rise to kyphotic deviations; and with these we have consequently and directly to deal. A blow upon, or a contusion of the spine, or a fall upon the back, particularly upon a hard and uneven surface, may likely lead to very serious consequences as to the integrity of the spine, and therefore should engage our earliest attention, irrespective of any deformity whatever. However general the ailment of the patient may be, if he manifests tenderness of the spine, the slightest indication of the awkward gait and posture which is so indicative of spinal trouble, or if he only complains about persistent pain in the stomach and the chest, or in deglutition, for which there are no local causes, your attention should at once be directed to the spinal column. In placing the patient undressed in the supine posture upon the table, you will be able to ascertain the tenderness of the spine in four different ways: by touch; by percussion; by moving a hot sponge along the spine;* and by placing the two electrodes of a galvano-magnetic apparatus alongside the spine, and putting it into action. In children you may likewise institute the following movements to that effect: whilst an assistant fixes the pelvis of the patient you grasp the chest laterally with both hands, and institute either lateral or tortuous movements. If the cervical portion is concerned, the assistant fixes the chest and you move the head. Or you place the hand upon one portion of the spine, and let the pelvis be lifted and moved by an assistant. In fine, you may gently but suddenly push the pelvis upward.

By either or all of these manœuvres you will certainly establish the fact of spinal tenderness, if there is any. If there was no other symptom indicative of a serious malady, *that* alone would be sufficient to put you on your guard, and to induce the adoption of measures calculated to prevent the mischief which we are perhaps unable to cope with when once established. For, gentlemen, let it be emphatically understood that the amelioration of posterior cur-

* Copeland.

vature is at best questionable, and its cure entirely out of the question, notwithstanding the assurances of some authors.

Mr. Samuel Solly, in his lectures on the diseases of the spine, uses strong and unequivocal language in reference to this point: "That but ignoramuses or knaves could assert" the removal of an existing antero-posterior curvature. From pathological and clinical investigation, I have come virtually to the very same conclusion.

In the commencement, surgical art is positive and beneficial. We are able to arrest the progress of the disease. We can avert, but not remove its ulterior consequences.

Having made your diagnosis, what is to be done to give aid and comfort to our patients?

The very first and indispensable axiom should be *rest* and *position* of the spine, so as to protect it against superincumbent pressure, jarring, and concussion. There is no mechanical apparatus, however ingeniously constructed, praised, and patented, which can fulfil this urgent indication, as long as the erect posture and locomotion are allowed. You have to insist upon the horizontal position. This is, then, the first and indispensable remedy which you have to adopt, and in this position you have to keep the patient *as long as there is a vestige of the local trouble left.* I am fully aware that most parents object to this ordeal; that there are many practitioners who look with disfavor upon the confinement of such patients, and likewise that it is somewhat difficult to keep the patient down, more particularly after the active suffering has been mitigated. But, gentlemen, we have here nothing to do with the notions and aversions of anybody, but merely to deal with the subject-matter. You have seen quite a number of pathological specimens. You have had ample opportunities to investigate their physical condition, and you will, therefore, readily admit that patients so afflicted cannot bear either the superincumbent weight of the body or locomotion. Most of the patients from whom those specimens were derived had been indulged in both. It is therefore self-evident that none had preserved the constitutional health, in spite of the fullest enjoyment of open-air exercise. The very instinct induces the patients to seek rest. Can we learn nothing from clinical observation?

It is said that the confinement of the patient is detrimental. Suppose it is, it is nevertheless necessary. But I am by no means prepared to admit the truth of such an assertion. I have certainly had no less opportunity of observing the effects of confinement than any one else, and from these observations I have derived opposite conclusions. In the moment you give rest to your patients, they at once improve in appetite and sleep. Either is directly beneficial to general health, irrespective to the ulterior changes which must result from the mitigation of the disease. I have had patients for years in the recumbent posture, and I have saved their life and health, which I feel persuaded could not have been effected by other means. Moreover, there are ways to render confinement less irksome, and with these I shall soon make you acquainted.

If there is as yet no deformity of the spine, an even hair mattress is as good as anything else. As soon, however, as a part of the spine projects, an ordinary mattress would not answer, inasmuch as it would cause too much undue pressure upon that place. In such a case, a water-bed would be requisite. The benefit of the latter in the treatment of antero-posterior curvature cannot be too highly estimated. It affords more comfort than any mattress, and it diffuses the contact over the entire posterior surface of the body by adapting itself to its form. The price heretofore charged for water-beds has been rather exorbitant, and prevented its general usefulness. Messrs. Norton & Co., of New York, have therefore been induced by me to manufacture water-beds of different sizes, and accordingly modified prices. Those with double ticking are preferable, because more durable.

It may be opportune to acquaint you with the arrangement of the water-bed. The bedstead should correspond to the size of your patient, and be so placed as to be accessible to light and air. If it is narrow, two pieces of siding are desirable to prevent the water-bed from rolling off. A firm and smooth base, either in mattress or pilasters, should be procured, upon which the water-bed is directly placed. The latter is easiest filled, with the assistance of a funnel, and not more than three-fifths of its capacity. It is already sufficiently filled if the two sides do not touch when the patient is placed upon it. Being assured that

there is no leakage, you cover the water-bed with a folded blanket, so as to interpose a bad conductor, and a material which will absorb the perspiration; over this the bed-sheet comes. Should the patient be unruly, he ought to be fastened, with a view to prevent his rising. For this purpose the blankets should be tightly fastened to the sides of the bed, or to the underlying mattress; and to the blanket pieces of webbing are fixed, which run in an oblique direction from behind, forward and outward, over both shoulders, and another across the pelvis. It might be desirable to put high wheels to the bedstead, or the latter upon a wheeling platform, so as to roll the patient from one room into the other, or into the open air, if the locality permits. The patient must of course be fed, and get accustomed to the use of the bed-pan. In order to use the latter, the water must be pushed away, so as to make room for it.

Having thus provided for the rest and comfort of your patient, you are then in the position to employ further means to diminish the local trouble. When active symptoms prevail, the repeated application of a few leeches at the affected locality is certainly very beneficial in reducing pain and hyperæmia. Professor Esmarch, of Kiel, attaches great importance to the systematic and persistent use of water and ice-bags to the injured spine; and I have reason to believe that the cold temperature is the most available appliance in recent injuries. The patient has of course to assume an appropriate position, so as to render his spine accessible. Chapman's ice-bags are useful for this purpose; oiled silk answers next best; the worst are bladders, which allow transfusion, and very soon emit a bad odor. The oiled silk should be suspended by a cord, either from the ceiling or from a rope drawn longitudinally over the bedstead; otherwise the bag might be upset, and the bed thereby wet. If ice is used, it may be advisable to cover the spine lightly with a layer of flannel, which would modify the intensity of the temperature and absorb the moisture from the bag. The length of time during which these applications should be made is obviously determined by the nature of the case and the effects produced. Sometimes cold applications are not well borne, and the supine position may be too irksome to be endured for any length of time.

By this simple proceeding I have effected more in arresting the local disease, and in averting curvature and other aggravations, than by all the extolled remedies, both constitutional and local, that have found their place in surgery.

Recumbent posture, rest, local antiphlogosis, comprise then the treatment of incipient cases of posterior curvature; and their judicious application affords all desirable relief to the patient. They alone arrest the disease, and consequently put a stop to the growing deformity. From time to time repeated and careful inspections should be instituted, to ascertain the progress or regress of the disease; and all symptoms should have been silenced for some time before the treatment is changed. It may not be safe to alter the position in six or twelve months. In children of that age, time is of little, but health and form of great consequence. As a general thing, gentlemen, the patients do not only not suffer from the confinement, but, on the contrary, bear it exceedingly well. If you should find, however, that your patient does not progress as well as might be expected; that he becomes pale and attenuated, which cannot be accounted for by the advance of the local trouble, and even without this change, it may be advisable to allow *passive* open-air exercises. In order to accomplish this without detriment to the spine, I have constructed and frequently employed *a dorsal cuirass*, fitting accurately to the posterior half of the trunk, and thus supporting the spine and

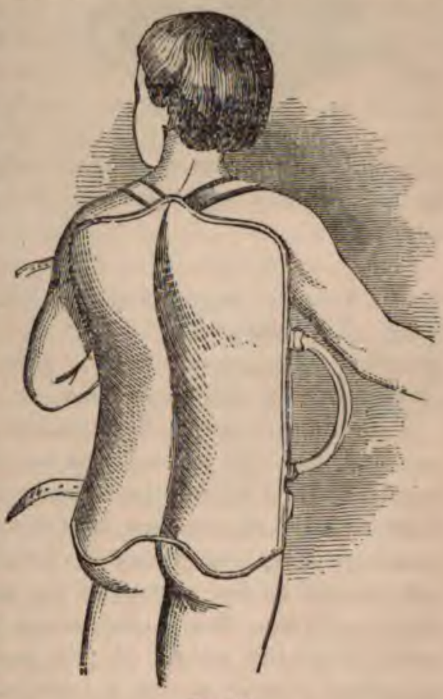

FIG. 28.

body so perfectly that its form is thereby maintained without the possibility of an alteration (Fig. 28).

The making of the cuirass requires a well-taken cast of the body in plaster-of-Paris. The cast serves as a last upon which the apparatus is framed.

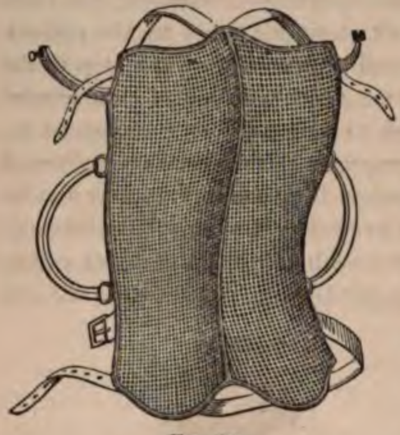

Fig. 29.

The cuirass consists, you perceive (Fig. 29), of a frame made of soft iron, with a piece along the spine. The intermediate space is filled with galvanized wire webbing, soldered to the frame. If well adjusted, the apparatus should fit to the cast like a shell, or like the gum-plate of artificial teeth. The frame is then well padded, and covered and fixed to the body by a belt and two shoulder-straps. At the side of the instrument there are two leather handles affixed, by means of which you can lift and carry the patient in a horizontal position.

Being securely placed in this apparatus, the patient may be drawn in a little wagon, or may enjoy the open air in a carriage drive. Thus the tediousness of the confinement is agreeably interrupted, the general health is properly cared for, and one of the objections to the imposed restraint overcome.

If the improvement of the patient proceeds satisfactorily; if you find that his general appearance becomes stronger and healthier; if he fattens up, exhibits good appetite and rest; if there remains no soreness at the spine; in fine, if all the symptoms of his local disease have vanished for some time, then, and not before, you may allow the patient *to creep on knees and elbows*, and take thus some active exercise alternately with rest. With the return of pain and febrile excitement the recumbent posture should be resumed, so as not to risk a relapse of already subdued troubles. But if, on the contrary, the patient continues to do well by this treatment, you may

supply him with a supporter, and permit the erect posture. For a long time you have still to watch the effects of erect locomotion upon the spine and the constitution, and take prompt measures if new inflammatory symptoms should manifest themselves. The patient should, moreover, be advised not to indulge in violent exercises, even for years to come; for I have observed relapses from such causes in perfectly relieved cases as late as five years after the subsidence of the active symptoms. In one of them, terminating fatally, two osteophytes had been fractured which had held the vertebræ together.

About the necessity and usefulness of mechanical appliances to the curved spine, there is yet some diversity of opinion among surgeons. In former times their efficacy was greatly overrated. Spinal supporters and stays were deemed sovereign remedies for kyphosis, and have commonly been resorted to. Pathological investigation and experience have, however, dispelled that error. The *very best* mechanical contrivance is nothing more than "*a monitor*" to the patient, *restraining undue motion* of the spine, and *slightly sustaining the superincumbent weight of the body.* Stays are silly and reprehensible. They are not substantial enough to support the spine, but they are calculated to press upon the vital organs and interfere with their important functions. Competent surgeons do not employ or recommend them.

There are quite a number of spinal braces in vogue, among which you may choose. You should, however, insist upon their accurate fit and efficiency. The former can be procured only by a cast of the body of your patient in plaster-of-Paris, upon which the apparatus is fitted and framed.

The efficiency of spinal supporters rests chiefly upon the construction of the belt, which should be wide, and so accurately surround the pelvis that it will not slip, and serve as a reliable foundation for crutches and the spinal brace. Most apparatus are faulty in that particular, and therefore utterly useless. The crutches are designed to lift the shoulders and carry their weight to the belt, without compromising the spine. The spinal brace is calculated to constrain the spine from undue motion by means of a well-fitted and padded dorsal plate. Such an apparatus I beg now to exhibit (Fig. 30). You notice that the belt fits

accurately and firmly to its cast, and yet is light, being made after the plan of the cuirass. It consists of four pieces, connected by metal hinges, which facilitate its application, without detriment to its solidity. The dorsal plate, D, should be perforated,

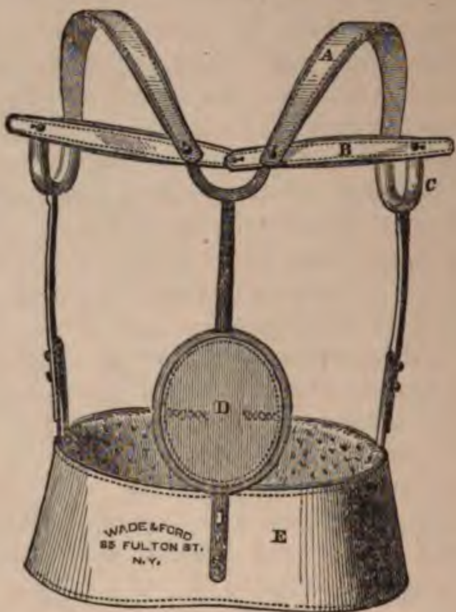

FIG. 30.

so as not to impede perspiration. The crutches, C, are made of two pieces, in order to shorten or lengthen. If the patient should grow, or his form be materially altered, the apparatus would lose its proper adaptation. In that case a new cast should be made of his body, and the apparatus altered accordingly.

I can, of course, give but general directions as to the construction of such an apparatus, and you are to modify the same according to the individuality of the case. Thus, it may be necessary to raise one shoulder higher than the other, and to extend the dorsal plate to one side, over the ribs, if the spine tends likewise toward a lateral excurvation, etc.

Eulenburg, Klopsch, and my esteemed friend, Schildbach, of Leipsic, deem it necessary to immobilize the spine by diverse

means, both in the horizontal and erect posture. The first employs bandages impregnated and stiffened by starch or dextrine à la Seutin; the second prefers a solution of gutta-percha; the last, gutta-percha in substance, properly moulded to the posterior and lateral surface of the body.

I must confess that I have not resorted to either of those restraints, simply because I deem restraint superfluous, and not unlikely prejudicial to the actions of lungs and heart. In taking a plaster-of-Paris mould of the body of such a patient, as I have done so often, you notice that the posterior half cracks much more readily than in front. It would seem from this fact, that the patient respires much more posteriorly than with the front portion of the thorax. If this is so, restraint of the thorax is objectionable, for self-evident reasons. Moreover, I consider shoulder-straps and a belt across the pelvis sufficient means to keep the patient down, and to immobilize the spine as much as it can bear. As to the mechanical restraints in the erect posture of the patient, I can express in a few words the estimate in which I hold them. Leave your patients on their back or stomach until the disease of the spine has terminated, and the newly formed adventitious tissue has become consolidated; in other words, until the patient has completely recovered from the fundamental disease. If this has been achieved, the patient may rise and move about without any fear. He has passed beyond the necessity of mechanical support.

The spinal brace cannot be appropriated as a substitute for the horizontal posture. Dr. C. F. Taylor exhibited, in 1853, a spinal supporter to the Medical Society of the State of New York, by which he proposed to straighten the incurved spine The apparatus has in every other respect the ordinary construction, but the spinal brace consists of two pieces, which join by a hinge at the precise point at which the spine protrudes most. By means of a screw he alters and fixes the angle at will. The lower part of the brace connects with the belt, the upper with an arrangement by which the shoulders are grasped. When the screw is brought into action, the upper part straightens and forces the shoulders backward, and with them the upper part of the spine.

To this suggestion I have the following objections:—1. That

Dr. Taylor has taken out a patent to protect his alleged invention. In the construction there is no mechanical originality displayed. The hinge-joint has been freely employed, with and without the screw to graduate its movements. It is part of my orthopædic shoe. The apparatus is either good and effective, or bad and dispensable. If the former, it should have been turned over to the general use of the profession. No liberal-minded physician will adopt a policy by which he deprives the world of his knowledge, and the unfortunate sufferers of the benefits of his invention, irrespective to the injunction of the Code of Ethics of the American Medical Association. If the apparatus is bad, nobody will infringe upon it.

It was with some surprise that I read the Transactions of the State Medical Society, and found Dr. Taylor's apparatus prominently figure among the contributions printed at the expense of the State. Perhaps, however, the Society was not aware of the fact that Dr. Taylor had forfeited his right to such a privilege!

2. Dr. Taylor has these apparatus manufactured, and keeps them ready made, irrespective to the form and contours of the patient.

3. The belt is too narrow, and bends back and upward as soon as the screw is applied.

4. The upper part of the spinal brace comes in contact with the body, and works upon it as on hypomochlion, which of course cannot be borne.

5. The instrument is faulty as to the presumption upon which it rests—namely, that a carious spine can be straightened at all. The most superficial knowledge of morbid anatomy must recognize the fallacy in the premises.

The treatment of incidental complication will now occupy our attention for a brief space of time:

1. In the malformation of the thorax in kyphosis, we recognize a compensating provision of nature, with which we have no pretence of interfering. The thorax widens in proportion to its loss of length. The change provides the necessary space for the lungs and heart, which dare not be interfered with by mechanical constraint.

2. The general attenuation of the body is usually proportion-

ate to the degree of deformity. The more we prevent the latter by proper treatment, the more we obviate or ameliorate the former. Inasmuch as the attenuation results from copious suppuration, we have to meet it by the most generous diet and tonics.

3. Paralysis and contractions yield mostly to a rigidly enforced horizontal position of the patient, and local antiphlogosis.

4. In consecutive abscess (dorsal, lumbar, psoas, and iliac abscess), we advise to puncture them as often as they fill, if they are circumscribed; but to lay them freely open and divide the fascia when they are diffused. By the former procedure you relieve the parts in a most direct way, and limit the additional suppuration of the fistulous tract; by the latter, you prevent the mischief of the matter burrowing below the fascia, *ad infinitum.*

The suggestion of Nélaton, to close the fistulous tracts by injecting tincture of iodine, is neither advisable nor practicable, and experience has been against it. You gain nothing by obliterating the tracts, should you ever be successful with the injection, since you cannot reach and exterminate the cause. And as long as the latter exists, the matter will force its way in the old or a new direction.

Constitutional treatment is but rarely required in these cases, provided they come at an early stage under proper hygiene, and appropriate orthopædic treatment. If the cases have, however, advanced to extensive caries and suppuration, and the patients suffer proportionately in general health, medication may be needful. Cod-liver oil, sweet cream, fresh butter, fat in general as an article of diet, and medication, are in their place to counterbalance the loss of substance. As good as any of them are eels, the head and belly part of halibut. The fat and gelatine of these fishes are very digestible and nutritive. In their preparation frequent changes should be made to suit the palate. My friend Payne, of Florida, is about manufacturing concentrated extracts of the green turtle according to the method of Liebig; he had the goodness to place a sample at my disposal, which was certainly very excellent. I believe that this article will be a most available substance of diet for patients of this class. Extractum carnis is likewise commendable. I am no great admirer of drugs in these cases. The preparations of iron upset the digestive powers, and produce not rarely diarrhœa, though

they seem to be strongly indicated against the anæmic condition of the patient. At any rate the milder preparations, as for instance the dragées with carbonate of iron, the lactate of iron, the tinctura ferri acetatis, etc., should have the preference. Next in order is quinine. It controls in a measure hectic fever, and is perhaps the only prophylactic against pyæmia. But quinine occasionally disturbs the digestive apparatus, and is therefore to be used with due discretion. Anodynes have a moderate value in composing the patient and insuring some immunity from pain. These remedies are indirect tonics; but the true and direct tonic is food, on which you should chiefly rely.

If the water-bed is a desideratum in the initiatory stage, it is an absolute necessity in the advanced forms of these diseases, to protect against bed-sores, which but too readily occur.

Schildbach advises gymnastic exercises as part of the after-treatment. He suspends the patients by their arms, by Kunde's walking apparatus and Glisson's halter, and thus appropriates the weight of the body as an element of extension.

Notwithstanding the great partiality of that author, his candor is equally marked. Thus, in his second report,* he says all he had accomplished in the treatment of kyphosis was the arrest of the curvature; he could not boast of the same brilliant results as Berend, though he had, under direction of this gentleman, treated two children in supine posture almost a year. The curvature exhibited no change after that period.

All he expects from methodic gymnastics is to straighten the lordotic portion of the spine, and improvement in the general health of the patient.

* Leipsic, 1864.

CHAPTER VI.

II.

LATERAL CURVATURE OF THE SPINE.—SCOLIOSIS.

Causes and diagnosis.—Lorinser's and Buehring's pathological views.—Delpech's muscular antagonism untenable.—Muscular contraction a fiction of Guérin.—Meyer's experiments with reference to torsion of the spine.—Pathological anatomy.—Prognosis.

FEW subjects of pathology have received more attention on the part of the profession, and in none have the combined efforts of scientific investigation been more barren of practical results than in scoliosis. For centuries it has been known as a formidable and unmanageable infirmity, and as such it is still recognized by competent and candid practitioners. Not only that the proximate cause of this deformity is shrouded in obscurity, but even its remote cause or causes are still the subject of dispute and speculation. To recite all the plausible and partly ingenious hypotheses which in the course of time have been advanced, might be interesting, but of little practical benefit. Most of them did not outlive anatomical and physiological tests. Those that did, belong to history, and I feel little inducement to stir the dust.

However, it should be borne in mind that the investigation of the subject is embarrassed by almost insurmountable obstacles. Incipient cases of scoliosis, which alone would disclose the pathological condition of the textures concerned, can scarcely be had for anatomical examination; and advanced forms exhibit merely results, but not the direct causes. We are therefore limited to clinical facts, and much is left to speculation.

The old theory, imputing in a rather undefined way to the osseous structure of the spine the exclusive cause of the deformity, had at no time acquired great sway, and was speedily superseded by the theory of Delpech.

Lorinser* has recently attempted to rejuvenate the same theory in a series of contributions, highly valuable in many respects. The cases selected for his pathological investigation exhibited softening, general infiltration, and osteoporosis of the vertebral bodies; and he concluded that both scoliosis and kyphosis are akin in their proximate cause, and that the rapidity of their respective development governs the shape of spinal deviation. The morbid and structural changes, described by that author, we cannot fail to recognize as the characteristic rachitic infiltration with which either form of spinal curvature is undoubtedly compatible. But the error becomes self-evident when Lorinser strives to present that pathology for general acceptance in all cases of scoliosis, it being at variance with well-established clinical experience.

The same views have since been set forth by that author in an elaborate article which challenges criticism.† A careful perusal of the same has fully satisfied me that the ground is untenable upon which Lorinser rests his theory. I am rather surprised at his self-assurance, considering that he is not in the possession of a single anatomical fact that could be admitted as valid evidence of osteomyelitis of the vertebral bodies. It would seem as if Lorinser had reasoned himself into his belief from the subsequent consolidation of the scoliotic spine, and the formation of new bone in the neighborhood of the deflected spine, *post hoc ergo propter hoc.* But he himself precludes inflammation from rachitis and mollities ossium, where there is both softening and eventual consolidation of the osseous structure. As to new bone, we find it under the same condition everywhere when bones come in immediate contact, and act upon each other by use. Moreover, Lorinser narrows the definition of lateral curvature to that lateral deflection of the spine which coexists with torsion, whilst it is now fully understood that the latter is never observed in adults scoliotically affected. But to confound scoliosis with kyphosis, and ascribe to both the same structural changes, is utterly incomprehensible. The very clinical character of the two is so vastly at variance, that no diagnostic acumen is

* Bemerkungen über die Pathologie und Therapie der Rückgrats-Verkrümmungen. Wiener Med. Wochenschrift, No. 22, 23, 24.

† Von Pitha and Billroth's Surgery. Vol. 2.

needed to keep them asunder. The idea is preposterous that in scoliosis the vertebral bodies could be disorganized by so serious a malady as osteomyelitis for consecutive years, without a single symptom of manifestation; though we may incidentally notice in posterior curvature a slight lateral deflection, but this obviously is caused by defect, and not by interstitial absorption of bone.

From these objections it is not likely that Lorinser's theory will come in favor with the profession.

The doctrine of Delpech, of disturbed muscular antagonism, is still in vogue; and most orthopædic surgeons base their treatment of scoliosis on that cause. The meritorious and systematic labors of the late Dr. Werner* have, however, so thoroughly proved Delpech's theory as inconsistent with physiology, that no well-informed practitioner can any longer uphold it. With the firm guide of Dr. Werner's observations and experiments, we now perceive the fallacy and inconsistency into which Delpech has led us, yet we are still inclined to retain a plausible theory in preference to none at all.

I presume that you are not familiar with the writings of Werner, and hence I may consider myself justified in briefly adverting to his deductions. The antagonism of the muscular system has been based on the supposition that each muscle or each group of muscles was equally balanced by another muscle or group, and *that the form of the frame depended on the equal power of both.* Delpech consistently inferred from this supposition, that the form was necessarily disturbed as soon as this muscular antagonism was infringed by *a one-sided increase* or *decrease of muscular power.* Whereas Werner demonstrates that the *muscular antagonism is a gross error*, and *in reality does not exist.* In this assertion his experiments and physiological facts bear him out. His "theses" tend to prove:

1st. That there is no antagonism between muscles, as maintained by Delpech.

2d. That single muscles and the groups are unequally balanced, as has already been demonstrated by Borelli.

3d. That the balance of power is simply subservient to the will.

4th. That the full measure of muscular power will produce

* Reform der Orthopædie. Berlin, 1851.

results proportionate to the length, thickness, and leverage underwhich single muscles or groups act, irrespective of antagonism.

5th. That the muscle, if not actuated by the will, is physiologically at rest.

6th. That this rest is complete, and not impeded by the so-called muscular tonicity.

7th. That the muscular structure is endowed with contractile, but not with expansive powers.

8th. Hence, a contracted muscle cannot expand itself, but requires either the weight of the extremity or an antagonist to regain its full length to be ready for another contraction.

9th. The theory that a muscle becomes permanently contracted, and the extremity deformed when its antagonist is paralyzed, is *erroneous*.

10th. During a temporary contraction, the skeleton is drawn in the direction of the healthy muscle; but as soon as the contraction is terminated, it will return to its original position by its weight, or may be reformed by assistance. Thus the fore-arm will extend itself, though the triceps be paralyzed. When the weight does not aid, as, for instance, in paralysis of the extensors of the fingers, it requires the other hand. In paralysis of the facial nerve, laughing or speaking draws the face toward the healthy side. In this distorted attitude the face remains, because the contracted muscles, though at rest, cannot expand themselves. But the face can be pulled straight, and will remain so until again disturbed by a new exertion of the facial muscles.

11th. Permanent muscular contraction necessarily emanates from a morbid process, and cannot be regarded as a physiological act.

12th. A muscle can be at rest, whether extended to its full length or shortened.

13th. Contraction is inseparable from shortening, but the latter may exist without the former.

14th. Most muscles combine with their antagonists to effect a motion in a third direction. Thus the flexors and extensors of the foot effect both adduction and abduction.

These numerous facts, supported by conclusive experiments

and observations, render Delpech's "muscular antagonism" untenable.

Its fallacy becomes, however, still more transparent as soon as its practical application is attempted upon habitual scoliosis; for it is utterly impossible, even among the warmest adherents of Delpech's theory, to settle the problem whether the dorsal muscles are on one side weaker or stronger than their antagonists. Nor are they able to decide whether the muscular preponderance exists on the convex or concave side of the deviated spine. At any rate, the dynamometer has not disclosed the fact that there is any preponderance of muscular power at all.

On a similar base rest the views of Jules Guérin and those of Stromeyer. When the former promulgated his theory of "Muscular Retraction" as the invariable cause of scoliosis, and the tenotome as its sovereign remedy; when he soon after adduced quite a number of cases successfully relieved by dividing the retracted muscles, the surgical world was electrified, and the suggestions readily embraced. The more sober surgeons of the time, Dieffenbach among them, at once remonstrated against the wholesale and indiscriminate use of the knife, declaring that only well-defined muscular contractions should be subject to operation. The clinical test, thus invoked and carefully instituted, led to perplexing results. For the muscles on either side of the curvature, in both the thoracic and lumbar deviation, would show themselves in one position retracted and in another relaxed, and the difficulties arose in determining which of them were to be divided. In the ensuing discussion on this point, some of Guérin's followers held that those muscles were contracted that were on the concave side, and *vice versâ*. The consequence of this uncertainty was, that both groups were subject to the knife; and, what was more astonishing still, both parties asserted the same good result. At this stage of the discussion, Malgaigne, in his excellent Mémoire* to the Académie des Sciences, protested against the abuse of tenotomy and myotomy. With reference to the division of the dorsal muscles, he pronounced the operations of Guérin in the Hôpital des Enfans Malades a total failure, rather aggravating than improving the cases. In order to decide between the conflicting reports on the merits of the pro-

* Paris, 1844.

posed new treatment of scoliosis, the Academy appointed a com mittee of inquiry, with Roux as its chairman. Guérin could no be persuaded to submit more than one case to the inspection o the committee; but the latter succeeded in collecting twenty four of his cases. Most of them were not only aggravated b the operation, but some completely disqualified to labor. Thu terminated the delusion of Guérin's muscular retraction; and eve since, his former adherents have been silent on the subject.

Stromeyer's theory of one-sided paralysis of the respirator muscles has never been seriously entertained and acted on.

There is yet another hypothesis, which ascribes to the disturb ance of the equilibrium of the body the cause of scoliosis. Ther are, indeed, some facts which seem to sustain that view. Th loss of an extremity by amputation; unequal weight on one sid of the body; a shorter limb, or a malposition of one of the lowe extremities, affecting the position of the pelvis, and so forth unquestionably give rise to a single or double lateral curvatur of the spine. You readily observe this deviation when th patient stands or walks.

On assuming a sitting or recumbent posture, at the same tim relaxing the contracted muscles, you will notice that the defo mity has vanished, and that the spine of the patient is as straig and as perpendicular as that of any other person, but, from th constant exercise, much more flexible. We have seen man instances of the usual distortions incident to hip disease, some c them of thirty years' standing, and yet there was no permanen scoliosis. From these facts it would appear *that a disturbance the centre of gravity per se is not sufficient to cause permanent d viation of the spine.*

Thus far the attempt to establish a simple and generall acceptable cause for *all forms* of scoliosis has proved a sig nal failure. Deficient as our knowledge is with reference to th pathology of lateral curvature, we know this much: that ther are different forms of this infirmity, arising from different morbi causes. Thus, we know that rachitis and endostitis may giv rise to scoliosis conjointly with kyphosis; that empyema mos commonly leaves a moderate lateral deviation of the spine, wit flattening of the thorax; and again, that wry-neck is never wit out more or less curvature of the cervical portion of the spin

But all these and other forms are not the subject of the present discourse. On this occasion I mean to concentrate our attention on that species known by the term of "*scoliosis habitualis*," that being the most frequent and disastrous in its results. As the pathology of this deformity is not as yet clearly established, we must content ourselves chiefly with clinical facts, and thus indirectly obtain as clear an insight into its nature as circumstances will permit.

First and foremost, it should be stated that the beginning of habitual scoliosis is entirely painless; that its development but rarely causes any serious constitutional disturbance; and that a moderate state of health is by no means incompatible with this infirmity. This fact is of significance, because it proves satisfactorily to our mind that there is no inflammatory or structural disease at the base of the difficulty. For this reason we had to take exception to Lorinser's views.

Suffice it to say, that I have never observed, in connection with scoliosis, any one of those symptoms *denoting a lesion of the spine, or any irritation of the spinal cord and its membranes*, except a moderate attenuation of the body, and this only in the higher grades of the deformity.

Nor has any other orthopædic surgeon, to my knowledge, placed on record any observation to the contrary.

2d. Scoliosis has not been traced to traumatic causes, which are apt to produce structural affections of the spine and its adjacent tissues.

3d. Scoliosis does not occur at a period of life in which the spine is easily deranged, either by traumatic or constitutional causes.

4th. Scoliosis occurs much more frequently among girls than among boys, being another evidence against a traumatic cause.

5th. Scoliosis is much oftener the concomitant of wealth than of poverty.

6th. Scoliosis is much more observed among the female population of large cities than in rural districts.

7th. Scoliosis originates most usually at the time of puberty, and in young ladies whose sexual development is protracted; whose menstruation is either imperfect or has not as yet made its appearance; whose condition is feeble from rapid growth and

confinement, *and whose spine is endowed with an unusual degree of flexibility.* From this condition we have, however, seen a few exceptions in girls of most unexceptionable constitutional health, strength, and maturity; in whom, however, the deformity never acquired any great extent.

8th. The boys whom I have seen afflicted with scoliosis were almost invariably of delicate and florid appearance; tall and thin, with highly flexible spines.

9th. Scoliosis is remarkably rare among so-called scrofulous individuals; and on the tolerably extensive field of personal observation, I have scarcely noticed one instance in which the patient manifested symptoms of constitutional affliction.

10th. Although many of my patients affected with scoliosis were, in a moderate degree, asthmatic, yet I recollect *but one case*, a Southern lady of some thirty years of age, that suffered simultaneously from pulmonary phthisis.

11th. Scoliosis prevails in the northern latitudes of the temperate zone, and diminishes toward the tropics.

In summing up these facts, and in excluding from consideration traumatic and dyscrasic causes, and likewise structural changes in the spine, we are reduced to a few points, which prove that *scoliosis bears a close connection to a certain age, to the female sex, its evolution, and a certain general condition of the system and the spine.* In these conditions collectively, lies perhaps the general pathology of scoliosis; and no author has in our estimation more appreciated them than our late friend Dr. Buehring, of Berlin, whose contributions * on the subject are entitled to respect. According to this author, a low state of hæmatosis at that period constitutes the general predisposition to scoliosis; that is to say, a hydræmic or anæmic state of the blood, with an inefficient nutrition of the various structures of the body, depriving bones and cartilages of their usual firmness and elasticity, and rendering them susceptible to an alteration of their respective forms. This state of the bones and cartilages he attributes simply to the poverty of the nutritive fluid, analogous to the blood of the lower animals, whose skeletons do not acquire the firmness observed in the higher animals. The softness of the bone is, therefore, the simple result of a low state of nutrition, and not of any

* Die Seitliche Rückgrats-Verkrümmung. Berlin, 1851.

specific structural disease; as for instance, rachitis, osteomalacia, ostitis, etc. Nor is the softness so great as to be affected by the weight of the body alone, though sufficient to give the spine an unusual degree of flexibility. The next and local predisposition to scoliosis is, according to Buehring, the natural deviation of the spine toward the right side of the thorax, which exists to a slight degree in every individual, being the result of a symmetrical weight of the spine by vital organs. This view is sustained by accurate measurements of Buehring and others, and is borne out by the fact that in almost all cases of scoliosis the spine deviates in that direction.

To these constitutional and local predispositions, external causes must be superadded to establish lateral curvature. Buehring charges the use of improper dresses, more especially the wearing of corsets, with prejudicial effect. Besides, hard school-benches without backs, and the habit of standing on one limb, are looked upon as the cause of throwing the spine out of the perpendicular. When this, often merely a bad habit, grows upon the patient without his knowledge, it gives rise to one-sided compression of the vertebral bodies and cartilages by the superincumbent weight, and thus lays the foundation of scoliosis. Thus far the views of Buehring are rationally acceptable, and conform with clinical observation. Most authors confirm, that prejudicial habits in gait and position have much to do with the establishment of scoliosis, and this is the reason why this form has been termed *scoliosis habitualis*. But it should be distinctly understood, that these habits alone are not a sufficient cause; superadded to them must be the peculiar condition of the system to which I have adverted.

Some writers have ascribed great importance to the principal use of the right arm and right side; but this seems to be an exaggerated notion, since, with few exceptions, everybody prefers the use of the right arm to that of the left, without becoming deformed thereby.

Whether the action of the heart in a diagonal direction accounts for the normal deviation in the thoracic portion of the spine toward the right, is open to doubt, since the most powerful cardiac action in hypertrophy and disease of the heart does not materially increase it. A few cases have been recorded in which

the heart occupied the opposite position, and the left hand was preferred for use; they are, however, so exceptional in their nature that no safe inference can be drawn from them. On the other hand, deviations of the spine to the left have been observed in which the patients were right-handed, and *vice versâ*, showing conclusively that the preferment of one or the other hand has little influence upon scoliosis.

No doubt there are other operative causes not sufficiently known or appreciated. Improper diet and sedentary life, violent dancing and late hours, must necessarily tend to enfeeble the constitution and increase the morbid predisposition. In two cases in my charge I ferreted out masturbation as a source of weakness of the system. But the calendar of causes is certainly not exhausted by those I have mentioned, and much will be left to the sagacity and penetration of the attending surgeon.

I have thus delineated to you the condition and causes which in all probability underlie incipient scoliosis. Its progress is hastened by their persistency, and by the deformity itself. You will easily comprehend that after the spine has once lost its perpendicular, and its individual vertebral bodies press with superincumbent weight obliquely upon the intervertebral disks, and eventually upon each other, the deformity must proportionately advance.

Some experiments of Bonnet and Pommiers upon the spine demonstrate in the most direct manner *the great elasticity* of the vertebral bodies. In flexing the spinal column forcibly, they noticed that the venæ azygos became unusually distended, and that on straightening it these veins collapsed. Since the intervertebral fibro-cartilages possess scarcely any vascularity at all, it is to be inferred that the venous blood was derived from the vertebral bodies, which indeed have a considerable complement of veins acting as emissaries between those of the spinal dura mater and the venæ azygos. Being, however, imbedded in, and protected by, the cancellated structure of the vertebral bodies, consequently in a situation where no direct compression can affect the veins, it follows conclusively that they are simultaneously compressed and relieved with the bodies. These observations are very important to the subject under discussion, and they are well calculated to throw some light upon the prox-

imate cause of scoliosis. For it is self-evident that, as long as the elasticity of the principal constituents of the spine remains intact, there is no physical possibility of the latter becoming permanently deformed, and that gradual loss of that elasticity is simultaneous with gradual deviation from the perpendicular. Hence we find that static deviations of the spine from declivity of the pelvis, existing in the second and third stage of morbus coxarius, for instance, have no permanent effect whatever upon the individual vertebral bodies; the long duration of the deformity, notwithstanding their unimpaired elasticity, being efficient protection.

The opportunities for post-mortem examinations in the early

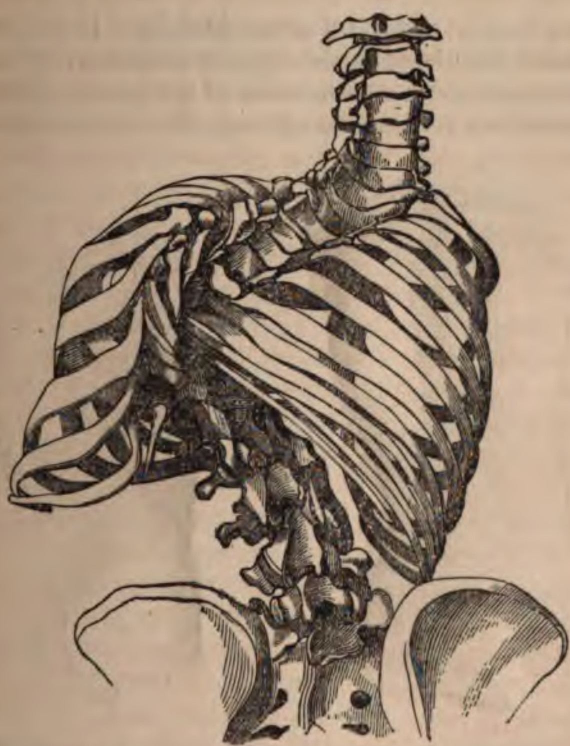

FIG. 31.

stage of the trouble are indeed rare. For the deformity steals upon the patient in an insidious manner. It grows slowly, and

affords time to the vital organs in accommodating themselves to the altered form of the skeleton. Their functions become but indifferently impeded. The general health suffers but little or not at all, and the patients attain mostly a fair duration of life. I have not become cognizant of a single death induced by scoliosis; and in but one case I found the diameters of the thorax so much diminished as to affect materially the respiration. The pathologist sees, therefore, only the final anatomical results of scoliosis, and not the initiatory and progressive changes of the spine. With the former I shall now occupy your attention. The diagram before you (Fig. 31) will give a general impression of the disfigurement of the skeleton in advanced lateral curvature.

The height of the trunk is of course diminished in proportion to the deviation, and the extremities appear comparatively too long. At a glance you notice the alteration of the thorax, which seems to be turned on its longitudinal axis, the convex side of the

FIG. 32. FIG. 33.

deformity receding, whereas the concave side is pushed forward. In looking vertically down upon such a skeleton, the thorax is seen to be compressed in one diagonal direction, whilst in the other the distance is materially enhanced. You notice this state

in the various plaster casts (Figs. 32, 33) which I have placed before you, and you will find that the difference in the diagonal diameters of the thorax accurately corresponds with the degree of the deformity. The points of measurement are the nipple on one side, and the apex of the scapula on the other. When considering the details of the curvature, we shall have no difficulty to comprehend the mechanism of the morbid form.

In both diagram and casts, a deep and angular impression can be perceived immediately above the ilium, at the opposite side of the dorsal curvature, giving an appearance as if the innominate bone had been pushed upward. Rokitansky* holds, that that side of the pelvis stands *actually* higher. I believe this to be an error. For if it was so, limping of the patient would be inevitable, of which I have not seen a single instance. The fact is, that the false ribs of that side approximate the ilium closely, sometimes overlapping on the inside. If you place the patient in the erect or recumbent posture, you will find the anterior superior spinous processes of both ilia, the larger trochanters, the patellæ, and the malleoli in corresponding positions, precluding obliquity of the pelvis.

The same author speaks likewise of a distortion of the pelvis, caused by the twisting of the os sacrum. Merkel has never observed it. If the pelvis is thus altered in its symmetry, it is certainly of no great account, since parturition is scarcely ever impeded. All I have observed in this respect is a moderate projection of the promontory, scarcely enough, however, to diminish in a material degree the antero-posterior diameter of the true pelvis.

In those cases of scoliosis that happen during the evolutionary period, a symptom is observed, the nature of which has greatly perplexed pathologists. I mean the torsion of the spine. That it has something to do with the development of the spine, is obvious from the fact that torsion is never observed in the lateral curvature of adults. Among the latter, this deformity is altogether of rare occurrence, and generally brought about by certain affections of the thoracic organs, empyema, pleuritic effusions by loss of substance (amputation of an arm), and by heavy tumors occupying but one side of the neck or trunk. For

* Lehrbuch der Pathologischen Anatomie. Band 2, page 170.

these forms Lorinser has introduced the very appropriate term of secondary scoliosis.

Heretofore it was held that the spinal torsion depended on the shifting of the articular processes of the vertebræ. To this view Prof. Herman Meyer* has justly taken exception on the following ground:

1. The articular processes have no definite or prescribed range of motion, and can neither favor nor resist the torsion of the spine; 2d. Spinal torsion may be met with at all parts of the vertebral column, although the oblique processes differ in shape and position; 3d. The torsion of the spine prevails at an age at which the oblique processes are not as yet fully developed.

In order to elicit the real anatomical cause of spinal torsion, Meyer has entered upon a series of experiments both instructive and conclusive.

It would carry us beyond the stated object of these lectures if I were to detail the particulars of the experiments. For our purpose, it will suffice to render you familiar with their practical bearing.

The experiments were made upon spines of various ages, after a longitudinal section at the junction of the vertebral bodies with their respective arches. Lateral and antero-posterior inflections of the anterior column established the facts:

1. Of a neutral axis; and 2d. Of an elongation and shortening of the spine according to the expansion and compression of the intervertebral fibro-cartilages.

In the spines of young bodies, the convex side of the inflection increased as much in length as the concave side shortened. In adult spines, generally, the expansibility supervenes the compressibility; and in one experiment of lateral inflection the latter was found to be naught, whereas the expansibility elongated the convex side by 30 mm. This, then, proves that in scoliosis the expansibility of the intervertebral disks assumes more material influence than has heretofore been supposed.

The experiments upon the vertebral arches collectively elicited:

1. Vertical sliding of the articular surfaces; and

* Die Mechanic der Scoliosis Virchow's Archiv, Vol. 35.

2. A marked compressibility and retractibility of the ligamenta flava.

Immediately after the separation of the arches, Meyer noticed that its column had considerably shortened. Hirschfeld had already observed this fact, and had estimated it as one-seventh of the whole length.* In one of the specimens (spine of a man thirty-seven years old) the shortening amounted to thirty-five mm. In another (spine of a girl fourteen years old), the difference from the former length was even more—namely, forty-five mm. The latter could be even enhanced fifteen mm. by compression; in all, therefore, 60 mm. In order to extend it to its former size again, a weight of four pounds had to be attached to the spine.

In comparing, therefore, the anterior with the posterior half of the spine, it was conclusively demonstrated that the physical endowments of the two differed materially; the former being chiefly expansible, the latter more compressible and retractible.

Proceeding to the question of the origin of scoliotic deviation, it should be kept in view that in the erect posture of the body the spine has to bear a not inconsiderable weight of the body, which it receives with the elasticity of its single components. The normal incurvations are placed in the mesian line of the body, and are more or less in tension. In a like manner are the abnormal deviations affected by the superstructure. And it is self-evident that, after the spine is once thrown out of the perpendicular, the superincumbent weight tends to aggravate the deformity. The physiological curves are prevented from exceeding the normal status:

1. By mutual compensation; and

2. By the ligamentous apparatus of the spine (ligamentum longitudinal anterius and posterius, and flava). Not so the lateral deformities. There is nothing to counterpoise the deviation; on the contrary, the supervening retractibility of the ligamenta flava come into play and contribute to increase the difficulty, in approximating the spinous processes and in distending the intervertebral disks. Inasmuch as this would be impracticable in the mesian line, the vertebral bodies turn laterally toward the convex side, whereas the spinous processes occupy the concave line of the deviation.

* Canstatt's Jahresbericht, 1849, page 69.

This much seems to be theoretically proved. But the author went further in his researches. If his conclusions were right at all, they might be demonstrable with the undivided spine. And for this purpose various experiments were instituted. The results of this last series of experiments may be summed up as follows:

1. In fully developed and confirmed spines of adults, the artificially produced lateral curvature is *without torsion.*

2. In the spines of newly-born children, scoliosis is readily produced; torsion is the constant collateral phenomenon.

3. With the spine of a seven-months old fœtus, the lateral curvature with torsion followed vertical pressure; and by giving the latter the opposite direction, the spine sprang into opposite scoliosis with a distinct elasticity.

4. In the spine of a boy nine years old, both phenomena were very readily produced.

5. In the spine of a girl fourteen years of age, scoliosis ensued with but moderate torsion. After the anterior longitudinal ligament had been dissected off, the torsion became perfect.

6. In the spine of a girl sixteen years old, lateral inflection was without torsion; but the latter ensued as perfectly as in the boy's spine, after the anterior ligament had been taken off.

7. In the spine of a man twenty-seven years old, perfect lateral inflection, and no torsion. The removal of the longitudinal ligament made no difference in the result of the experiment.

In a third series of experiments Meyer extended his investigations to the part of the ribs in scoliosis, and obtained corroborative results, showing that the ribs are influenced both in position and shape, as we find it in morbid scoliosis.

Thus one of the most vexatious questions has been settled beyond dispute; and with the decision a therapeutical base has been gained that is likely to lead us out of the labyrinth of confusion by which the subject has been surrounded.

The torsion is greatest at the most prominent part of the deformity, and diminishes in reverse ratio toward the extremities of the arch. In analyzing the details of the curvature, we notice:

1. That all the vertebral bodies implicated in the deformity have lost in height at the incurvation, which gives them a

wedge-like shape. The alteration of their form corresponds with the degree of the curvature. In very aggravated cases, the superior margin almost reaches the inferior one. In cases not so far advanced, the body recedes between the two projecting margins, clearly proving that the superincumbent compression is the cause of alteration of the shape.

2d. A similar deformity of the intervertebral fibro-cartilages, which at the concave side become so lowered that the vertebral bodies touch each other, and become faceted by friction (usur.) In such cases osteophytes spring up, immovably connecting the respective vertebral bodies. The cause of these osteophytes is to be ascribed to the using, and perhaps likewise to the unavoidable irritation of the adjoining periosteum.

3d. The oblique process at the concavity atrophied, sometimes elongated and flattened, not rarely anchylosed.

4th. The ribs at the concavity flattened like a band, and strongly bent forward at their angle with diminished arches. Their deformity is sometimes so great as not only to diminish the convexity of the thorax, but even to cause a caving in. Not rarely they are anchylosed with the vertebral bodies and transverse processes. Moreover, they not only approximate *each other*, but also the ilium. The ribs at the convex side are more angular and narrower than their normal form implies. In following the torsion of the spine and strongly bending at their angle, a considerable projection is thereby produced, that lifts off and upward the scapula, together with which they form a lateral hunchback, not to be concealed by any mode of dressing or wadding. In contrast with the other side, the ribs separate more from each other, which widens the space within the right side of the chest.

5. The sternum being drawn at its lower end downward and toward the left, partly out of the median line.

6. The dorsal muscles in a state of fatty degeneration, soft and pale, their insertions drawn under at the convex side, and *vice versâ*.

Most usually there is a double curvature, one comprising the dorsal, the other the lumbar vertebræ. In some instances, we find but one large curvature; in others three, and even four. In the latter case, the cervical vertebræ are implicated. As yet

it has not been clearly ascertained which of the curvatures is the primary, and which the consecutive deformity. Most likely the difference of causes produces in one instance the lumbar deformity primarily, and *vice versâ*. The consecutive curvature is known by the term of the compensating deformity. When the double curvatures are properly compensated by each other, the shoulders occupy the same position; whereas in single curvature, the shoulder at the convex side stands higher. As already remarked on a previous occasion, the dorsal curvature is with few exceptions constantly toward the right, and the lumbar toward the left. The cause of this regularity cannot be ascertained on the subject. That the aorta follows the course of the deformed spine is self-evident.

The diagnosis of scoliosis habitualis presents no difficulty. In incipient cases, a plummet-line suspended from the spinous process of the seventh cervical vertebra will show the slightest deviation from the perpendicular. In advanced cases, eye and hands will suffice. Some difficulty is, however, experienced in ascertaining the changes which the deformity may undergo during the treatment, either for better or worse. And as this is of importance, I will acquaint you with the best method to define such changes.

Formerly plaster casts of the trunk were taken from time to time, and their respective differences determined by comparison. This method is, however, deceptive. For, in order to take a mould of the trunk, the patient has to be placed in a horizontal position, which of course relieves the spine of its superincumbent weight. As long as the spinal column has retained a part of, or its entire abnormal flexibility, it will almost be impossible to get a true copy of the exact deviation which the patient presents in the erect posture. Per accident, we may obtain a representation greater or less than the exact deformity. Pretenders avail themselves of this circumstance for the purpose of deluding their patients, by artificially aggravating the deformity for the first mould, and take good care to get better forms for the subsequent ones.

In advanced cases of scoliosis, the plaster casts become more truthful, and therefore more reliable representations; because the flexibility of the spine has generally become extinct, the deform-

ity more stable, and all the anatomical parts concerned in the same have assumed a more permanent shape. But even in these, deception may be practised by placing one side higher than the other. In order to obviate possible error, Dr. Buehring has introduced a very ingenious contrivance, by means of which the contours of the form can be accurately taken in an expeditious manner. The principal part of the apparatus is a glass plate, sixteen inches by twenty in size, the frame of which is movable on an erect scaffold. The glass plate is divided by lines in half square inches. From the centre of the upper part of the frame a plummet-line is suspended. At the side of the scaffold a contrivance is affixed, designed to grasp around the arms of the patient below the insertion of the deltoid muscle, and at the lower part of the frame a horizontal projection is placed, upon which a movable dioptor is fixed upon a vertical staff. You see the apparatus in all its parts and simplicity before you (Fig. 34), and we shall now proceed to exemplify its practical usefulness. In placing the apparatus with its dioptor toward the light, and the patient behind it, you have then to adjust the glass plate so as to cover the entire trunk. Next you fasten the arms of the patient to the scaffold; and to render him thereby immovable, you take care that the patient stands with his spine in the median line of the plate as straight as possible, and with his heels together. By means of a delicate camel's-hair brush and some paint, you draw the lines of his contours accurately upon the glass; lastly, you suspend the plummet-line corresponding with the spinous process of the seventh cervical vertebra, and by means of the dioptor the curved line of the spine and its deviation from the plummet-line can be accurately marked.

FIG. 34.

After the patient has been released from his position, you

place a sufficiently large sheet of paper on the plate, and trace the lines of the body thereon. In this simple manner (Fig. 35) you can procure at any time, and as often as you deem necessary, the existing deviation of the spine, and compare it with the preceding representations, and thereby relieve your patients not only of a material expense, but likewise from exposure to menial hands in moulding.

FIG. 35.

Some authors, Buehring among them, discriminate several degrees of scoliosis. Inasmuch as the differences are not qualified by pathological changes, their scientific value is rather questionable; yet, designating the incipient or more advanced stages of a continuous infirmity, they may be admissible as conventional expedients, and as such we bring them before you.

The first degree (Buehring) manifests itself as an exception to the *normal* lateral curves; that is to say, the thoracic portion of the spine inclines more to the right, whereas the lumbar portion may be unchanged or slightly deviate to the left. The tension of the thoracic curve is about 2‴; the lumbar curve is not noticeable. The plummet-line passes on the left of the rima natum, notwithstanding that the spine has almost entirely preserved its perpendicular. There are not as yet secondary deformities of the trunk, and the hand can easily detect the curvature.

In the second degree, as represented in this case of a young lady, the trunk manifestly inclines toward the right; the plummet-line passes an inch to the right of the median line of the sacrum; the tension of both thoracic and lumbar curves is marked; the shoulder-blades have already changed their relative positions, and the ilium is more prominent. There is, however, as yet no torsion of spine, nor are there permanent changes in

CHAPTER VII.

TREATMENT OF SCOLIOSIS.

Prevention.—Treatment of the first degree.—Gymnastic exercises.—How and when to be used.—Second degree.—Horizontal position.—Objections and advantages.—Lateral extension.—Buehring's reduction apparatus.—Spinal supporters.—Hossard inclination belt.—Brodhurst's supporter.—Worthlessness of gutta-percha splints, and of elastic muscles.—Local treatment.

GENTLEMEN:—On entering upon this rather difficult subject, I shall briefly discuss the means of preventing scoliosis.

Believing, as I do, that the predisposition of that deformity rests with some defects in the sexual development of the patient, affecting, and eventually impoverishing the nutrition, preventive efforts should be made in that direction. The patient should not only be protected against influences likely to depreciate the physical standard of her constitution, but measures should be adopted to enhance its vigor, and thus fortify the frame against distortion. The faithful observance of the laws of physiological hygiene will mostly accomplish the object, medication being scarcely ever called for. Hence the patient should live regularly and generously, and abstain entirely from knick-knacks; should neither indulge in lascivious habits nor exhaust the physical powers by over-exertion; should alternate in proper proportion between rest and locomotion; wear comfortable dresses, alike protective against cold and over-heating; prefer physical and domestic to sedentary employment and overtasking of the mind; in fine, live for a period of a year or more for physical well-being alone, until puberty with its attributes has become fairly established, when the intellectual training may be resumed without hazard. In this simple but effectual way we shall safely carry young females through a dangerous period of their lives, and qualify them for their exalted mission.

With these Lycurgan rules we may come in conflict with the established habits and notions of high-life, yet there can be no compromise between right and wrong, between reason and folly. Irrational indulgence precludes the possibility of robust constitutions, and consequently of healthful enjoyment. In the same ratio as the system is depreciating, the mind suffers—"Mens sana in corpore sano."

When, on examination of your patient, you notice undue flexibility of the spine, you may at once set it down as the virtual commencement of scoliosis, and take prompt measures to avert the impending deformity. In order to realize the danger, you need but to place the patient in the erect posture and raise one of the lower extremities from the floor by a piece of board or book; the spine is at once thrown out of its perpendicular, presenting lateral curves of great tension. Such a condition is inseparable from general debility and languor; hence, prejudicial habits grow easily out of the want of support, and determine permanent deviation. It is extremely rare, however, that we are called upon for advice at that juncture; we find mostly already the commencement of actual scoliosis, or the so-called *first degree of Buehring.*

In treating this stage, the most scrupulous hygiene should be insisted on, and eventually remedies administered with a view to regulate and tonify the general system. Country residence or mountain air, cold bathing and animal diet, are commendable auxiliaries.

A system of diversified physical exercise should be adopted and discreetly persevered in, by which *gait and posture constantly alternate and change. It is most assuredly the best protector against prejudicial habits, and the best remedy to correct them.* Without going into superfluous details, some general rules should be laid down in the adoption of gymnastic exercises; otherwise, and if promiscuously indulged in, they might do more harm than good.

1. The exercises should, if possible, be taken in the open air, so as to obviate overheating of the body, and to sustain respiration with a proper alimentary supply.

2. The exercises should tax the entire muscular system at once or successively, and not exempt one part or the other.

3. The exercises should preclude vertical pressure upon the spine.

4. They should be moderate and discreet, so as not to exhaust the physical strength.

5. They should alternate with rest in the recumbent posture upon a firm mattress or lounge.

If the spine is already deviating from the perpendicular, *active exercises cannot be practised to a great extent without injury to the patient.* The "antiplastic" movements of Werner commend themselves as excellent substitutes for active exercises. The patient is placed upon a covered table in a dorsal position; the hands of the operator are employed to correct the deformity and to bend the spine over in the opposite direction; and, in fine, the patient directed to maintain the same by will for an hour or so at a time. Another competent person may take the place of the physician, to facilitate proceedings, which should be repeated several times during each day; or a movable footboard for the left limb may be adopted in substitution of the hand, which in raising the left side of the pelvis reverses the deviations. Aromatic frictions of the back and kneading of the dorsal muscles, and cold douche, are remedial additions.

The treatment of incipient scoliosis thus delineated, will effectually meet the indications presented, and, if systematically persevered in, give substantial relief to the patient. Mechanical support, or orthopædic beds, I deem dispensable for the first period. But if the patient should be so situated as not to be able to devote much time to the treatment, then, and only then, it may be expedient to provide a spinal supporter for day use. Of its proper construction I shall speak in the next lecture.

In the second stage of scoliosis, the local treatment of the deviating spinal column comprises the chief object of our attention, whilst the general management of the case remains the same as previously stated. You recollect that the deformity has already assumed a decided character, and its consecutive effects begin to show themselves upon the thorax. However, there are as yet no alterations in the shape of the individual vertebræ, nor has the torsion of the spine made its appearance. By mechanical means the spinal column can be brought into a perpendicular

direction. The scoliosis depends perhaps exclusively on the lessened elasticity of the intervertebral fibro-cartilages.

In dealing with the second stage, the question presents itself whether it would be wise to allow the patient the erect posture and locomotion, or whether it would be better and more appropriate to direct the recumbent one. The former has its advantages, which cannot be denied. They enable the patient to gratify the natural taste for change; to exercise the muscular system and procure better air than confinement to the bed would afford. But it should be borne in mind that the spine is already thrown out of its perpendicular; that the superincumbent weight acts upon it to great mechanical disadvantage, and that the patient is likewise permitted to perpetuate the old habits of prejudicial gait and attitude. It would seem as if there could be no conciliation between active exercises and arrest of scoliosis; that we had to relinquish the one or the other. Hence we cannot hesitate in accepting the recumbent posture as the better of the two, for thereby we get rid of superincumbent weight and bad habits. As already mentioned, the fear of confinement is certainly exaggerated, if found at all by clinical observation. Rest may be endured for some length of time with benefit, at least to the muscular system, whilst the wear and tear of the body is decreased and the character of nutrition enhanced. The alleged bad effects of confinement refer only to the excess of the same, and the physician has it in his power to curtail it should it operate injuriously upon the constitution. Although it might be better to remain on a firm mattress in a stereotype position, yet in order to relieve its irksomeness, a change of the bed with a couch, or a well-reclining arm-chair, as, for instance, that of Mr. King, in Broadway, New York, might well be conceded to the comfort of the patient. Nor would there be any reasonable objection to raise the bed into an inclined plane, so as to enable the patient to read or look about. Thus by ingenious contrivance some orthopædic surgeons have succeeded in constructing apparatus combining with the recumbent position, facilities for the pursuit of music, writing, drawing, and reading, without the slightest inconvenience or fatigue. Education may thus be carried on without interruption, as long as it is compatible with the objects of the treatment.

The antiplastic movements of Werner may be tried to reverse the position of the spine, but I apprehend that in most cases they will be found insufficient.

In former times, the so-called orthopædic beds were employed to overcome the deformity. Their chief design was longitudinal extension; some of them combined pressure upon the convex portions of the spine. The construction of those beds, of which a great variety has been introduced into orthopædic practice, bear great resemblance. A belt for the pelvis is connected by straps with a cog-wheel at the foot of the bed, and an appropriate apparatus for the head with the opposite part of the bed. After the patient has placed herself upon the bed, belt and head-piece are adjusted and the extension made by means of the cog-wheel. For the sake of lateral pressure, either cushions or wedge-formed pads were brought to bear upon the spine. During a long period the mechanical bed was the only remedy in vogue against scoliosis, and great ingenuity has been employed in its construction. Its unsatisfactory results were of course ascribed to the deficiency of its mechanical arrangements, and not to the invested

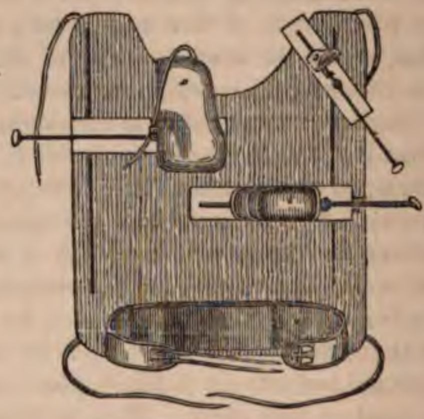

FIG. 36.

principle. Thus changes in the construction and improveme[illegible] were carried on until Guérin* and Major put a stop to them [illegible] demonstrating *that longitudinal extension was a failure, unless* [illegible]

* Rapport adressé à Monsieur le Délégué du Gouvernement provisionnel, Paris, 1848.

complished by direct action upon the curvatures. Since then mechanical ingenuity has been thrown into a new channel, with a view of constructing apparatus acting by lateral pressure and counter-pressure. The contrivances of Guérin and Major are very complicated and costly, yet they fulfil the object of simple and double lateral action, and may therefore answer in the second stage of scoliosis, which is not as yet complicated with torsion of the spine or an oblique shifting of the thorax. In the latter stages they are, however, inefficient, and unable to realize the presented indications. Buehring's reduction-apparatus, which I hereby submit to your inspection, is for many reasons a superior contrivance (Fig. 36), and I have found it in my practice a most serviceable instrument. It is not only simple, compendious, and applicable to an ordinary bed, but you may render it useful to all stages of lateral curvature. Its cost is but trifling when compared with those of Guérin or Major.

The pattern before you is designed for the third stage; I shall, however, show you how to convert it into an effectual apparatus for the second stage also.

You perceive that Buehring's apparatus consists in:

1st. A plate of sheet-iron, covered with ticking, or any other suitable material, to prevent the cold contact with the metal and soiling of the bed with rust. At its upper portion a sufficiently large piece is taken out for the neck, although this is immaterial. But the iron should be sufficiently strong so as to prevent bending. Parallel with the edges, and about two inches from them, a longitudinal fissure is made, sufficiently wide to admit a one-sixth of an inch screw moving to and fro.

2d. A well-bolstered belt, made of a steel spring, to be buckled in front.

3d. Three movable parts of well-bolstered soft wood, one for each deformity, and one to raise the left arm. In taking a profile view of these parts you observe the thickness of the two former, whereas the third is rounded and long enough to exceed the axillary cavity. They are movably fixed upon iron frames, and set in motion by a screw. The *modus operandi* is plain. When attached to the iron plate you can give them any position to the body you choose; and whilst the patient is fastened in the belt, and the pelvis thus rendered immovable, you screw

the pads against the spinous processes, and gradually press them over in the reverse position. The transverse processes rest upon the pads. In proportion to the thickness of the pads, the body is elevated from the iron plate, and the weight of the same is thus made use of to turn the spine on its longitudinal axis in the opposite direction from that we find it fixed in. The lower the wooden blocks, the less we can count on this action; and in substituting a plain pad of iron, we reduce it to a simple lateral shifting, and thus render the apparatus serviceable for the second stage.

The pad for the lumbar deformity (Fig. 37) is but narrow, but it should be large enough to embrace the side of the body. The pad designed for the thoracic curvature is of much larger size, in order to cover the protruding ribs and shoulder-blade, being of course in keeping with the proportions of the patient. Its exact form in the apparatus should be noted by you (Fig. 38) for future use. The

FIG. 37.

FIG. 38.

FIG. 39.

pad for the left axillary fossa is an erect piece of wood, rounde[d] and well covered (Fig. 39).

FIG. 40.

In this diagram (Fig. 40) you observe the patient in positio[n]

on the apparatus. The latter is fastened to the bed by straps. The pads are adjusted and the belt buckled. The limbs are free for exercise. In appearance we have a Procrustean bed, and can scarcely conceive how a patient can endure the same for any length of time. And so it seems to be in the first days of its use. But the patient becomes soon used to it, and in time it actually becomes indispensable to her comfort, so that she prefers it to a luxuriant mattress.*

The efficacy of this contrivance is great. When discreetly applied and attentively managed, Buehring's reduction-apparatus is capable of effecting such changes in the form of the spine as no other construction of this kind. In my humble opinion, it is at present the best known, and is deserving of your adoption.

The length of time a patient should continue in the recumbent position depends, of course, on the individuality of the case, and cannot well be fixed *à priori*. As a general rule, you are to discontinue the recumbent posture when the morbid flexibility of the spine has subsided, the deformity been reduced, and when in the erect position the spine shows no further tendency to deviate from the perpendicular. In some instances this result may be accomplished in a few months, in others even a year, or more time may be required. The improvements of the deformity advance conjointly with the growing constitutional strength, for as long as the general system remains in a debilitated state, the undue flexibility will likewise perpetuate its existence. If the patient should be necessitated to interrupt the treatment, we must then content ourselves with the use of the apparatus during the night, and provide a spinal supporter for

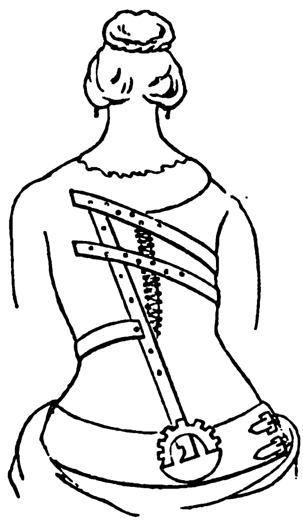

FIG. 41.

* The pads ought to be accurately adapted to each case, and for this purpose carved on the plaster-of-Paris cast of the patient.

day use. The same should be done with convalescents to avert relapse.

The history of spinal supporters is the same as we have mentioned with reference to the orthopædic bed. They were originally rude, and constructed for longitudinal extension. The head was suspended by a steel spring, ascending on the back from the belt and fastened to the upper extremities. Hossard was the first who constructed a spinal supporter on the principle of lateral pressure and counter-pressure (Fig. 41). Tavernier* speaks of its efficacy in high terms of approval. Nevertheless, Hossard's Inclination-belt has fallen into disuse by subsequent improvements. To enumerate all the inventions in this line would be an ungrateful task, and scarcely realize the value of our time. All of them can be reduced to the same principle of lateral counter-pressure, to which the support of the arms is added. I beg to lay down the rules for the proper construction of the like apparatus.

1st. An accurate cast of plaster-of-Paris taken of the patient is indispensably necessary to give to the supporter *a perfect fit.*

2d. The pelvic belt, being *the mechanical foundation of the apparatus*, should be most accurately adapted to the pelvis, according to the suggestions made on a former occasion. Most instruments are deficient in this respect, and lose their usefulness in proportion, however ingeniously constructed otherwise.

3d. Two pads, intended to support or press upon the deviated portions of the spine and ribs. They should not only fit well, but likewise move on their respective supporters, so as to remain in place, though the body may alter its position.

4th. The brace, or braces, for the pads should be adapted to the deviation of the spine, and to the form of the trunk in general.

Some surgeons give the braces the elasticity of a spring, others move them by endless screws, but most make them stationary. The last mode I prefer, as it does not interfere with the stability of the apparatus. To act by a sufficient pressure, so as to diminish the tension of the curvatures, whether by springs or endless screws, seems to be utterly impracticable. At any rate, I have observed that it affects only the position of the belt, and

* Notice sur le traitement des difformités de la taille au moyen de la ceinture, sans lits à extension ou béquilles. 1841.

not the deformity itself, more especially if but one pad is set in operation. The reason is plain. For either spring or endless screw you require a firm point from whence they act, which the belt cannot afford. The resistance to be overcome by such action is conjointly effected by the superincumbent weight of the body and the deviation of the spine, against which the best adjustment and the greatest possible solidity of the belt are no mechanical counterpoise.

All we may reasonably expect from a spinal supporter is to prevent the progress of the deformity, and retain the same *in statu quo*. My esteemed friend, Bernhard Brodhurst, Esq., the studious and talented surgeon of the Royal Orthopædic Hospital, of London, has recently suggested a spinal apparatus,* with a view of accomplishing thereby radical relief from scoliosis. He gives the following description of the same: † "The instrument, to which I desire to direct attention, consists of a frame and a lever, and loops upon it. The frame is formed of a pelvic hoop (belt), of crutches springing from it, and rising to the axillæ, and of a connecting dorsal band, which, uniting the crutches, is placed at the superior extremity of the primary curve. This forms a frame which cannot tilt. The crutches are made to lengthen, and the dorsal band is also movable, so that together or separately they may be raised as the curve is opened. Upon the centre of the dorsal band a lever moves on its axis. It is moved by means of a long screw, which is attached to the pelvic hoop, and, rising to the top of the shoulder, is connected to the shoulder-sling or loop. This shoulder-sling is formed of a ring of gutta-percha; it is accurately moulded to the shoulder, and lies upon the clavicle, the scapula, and the superior ribs beneath the axilla. It is placed on the shoulder, which corresponds to the concavity of the primary curve. The convexity is supported by a large pad, which embraces all the ribs that are connected with the vertebral curve. This pad is attached to the lever by a short arm, which may be shortened as the curve is opened."

Brodhurst relates some cases successfully treated by the apparatus, and exemplifies the amount of relief by diagrams taken

* On Lateral Curvature of the Spine. London: John Churchill.

† Page 54. *Ib.*

from life. At first sight, it seems almost incredible that a radical cure could be achieved in the erect posture, and by so slender means as the lever and the shoulder-hoops. Yet Brodhurst is an accurate observer, and a truthful recorder of facts. Without deliberate reflection and diligent test, no doubt should be attached to his statement. I therefore deem it but proper to enter on this occasion into a careful criticism of Brodhurst's spinal apparatus, for which so important qualities are claimed by its inventor. With laudable modesty Brodhurst acknowledges his indebtedness to Guérin and Lonsdale for the idea of unbending spinal curves; to Mr. Evrard he accords his share in the construction.

Now, gentlemen, in placing this apparatus (Fig. 42) before you, it may seem as if it did not differ from the usual spinal supporters. A closer inspection cannot, however, fail to arrest your attention with reference to some material modifications and alterations of the usual type.

FIG. 42.

There is the belt, the pad, and the crutches, as in others. You notice however, that the crutches are connected with a cross-band which gives an unusual degree of firmness to the apparatus. Again, whilst in most others the dorsal brace is stationary, the lever in Brodhurst's instrument moves on a pivot with great power, actuating simultaneously the pad and shoulder-hoop, and thus operating in opposite directions. Whilst, therefore, the pad is brought to bear upon the dorsal curve through the ribs, the opposite shoulder is lifted and drawn to the other side, by which the weight of the spine is changed in the opposite direction. The *modus operandi* of the instrument is therefore equal to the antiplastic movement of Werner, which in fact it renders permanent.

From the value which I have attached to the antiplastic manipulation of the latter, you may infer my estimation of the practical utility of the apparatus. But in order not to overrate its

serviceability, you should bear in mind that it can only affect the curves as long as the spine has retained its flexibility.

I have had occasion to employ the apparatus in some incipient cases of scoliosis, and can bear testimony to its practical value. This diagram (Fig. 43) exemplifies its application upon a patient.

In the third degree of scoliosis the extent and character of the deformity admit of but slender hope for improvement, if any. Our therapeutical object is to reëstablish flexibility of the spine and mobility of the ribs by all the means at our command. For if the interested portion of the skeleton is unchangeably fixed, no alteration of curvature can be effected.

FIG. 43.

For this purpose I employ Buehring's. reduction apparatus during night and day; use powerful frictions of the back with phosphorated oil, apply a strong current of galvanism in order to invigorate the degenerating muscles, and resort likewise to the antiplastic manipulations of Werner. If I succeed in rendering the spine and ribs again movable, I treat the case as advised under the previous degree. Should, however, the case resist all efforts, then it may be advisable to prevent its advancement by an appropriate spinal supporter.

A completely confirmed scoliosis with anchylosis of costal articulations and the intervertebral union is equally unsusceptible to amendment or advancement.

The fourth degree is therefore, and in a therapeutical point of view, "*noli me tangere.*"

Addendum. Herman Meyer raises the only valid objection against the recumbent posture of which I have as yet heard, and his reasoning is so pertinent and logical as to command the gravest consideration.

The recumbent posture, says Meyer, is so plausible, because it takes away from the spine the weight of the superstructure,

which otherwise would tend to increase the lateral curvature. On the other hand, it should not be ignored, that the recumbent posture of the patient has the tendency to diminish the normal thoracic curve of the spine, more especially when it is still unduly flexible. According to Meyer's experiments, that curve is the very best counterpoise of lateral curvature. It follows, therefore, that the opening of the normal thoracic curve favors scoliosis.

Again, if it is true that the torsion of the spine of young patients is inseparable from scoliotic deviation, as Meyer seems to have proved by his researches, it would follow that no mechanical means have any effect upon the curvature which do not likewise act upon the coexisting torsion. All the braces with which I am familiar fall short of this indication, and would seem to be useless. For they all act upon the ribs, and upon them alone, it strikes me that it would be much more easy to bend and permanently deform the ribs than to effect the reduction of the spine by these means.

The views of Meyer have consequently upset the entire therapeutical plan upon which the treatment of scoliosis has heretofore been conducted; and I cannot conceive how the gutta-percha splint of my friend Schildbach, or the "elastic muscles" of Davies, could make any difference in the result.

At any rate, the experiments of Meyer have opened again the discussion on the subject, and farther researches would seem to be needed to settle the mechanical questions involved.

CHAPTER VIII.

DEFORMITIES OF THE NECK.—TORTICOLLIS.—SPASTIC AFFECTIONS OF THE CERVICAL MUSCLES.

THE cervical region is likewise subject to deformities. In most of them the head is temporarily or permanently drawn out of its perpendicular. Extensive burns bring about such results. Inflammation of the apparatus of the spine and its pathological consequences disturb more or less the position of the head. Next, there happens a congenital deformity of the neck known by the term of wryneck—obstipitas capitis, or torticollis. And lastly, convulsive affections of the cervical muscles occur, commonly emanating from some affection of the spinal cord, which incessantly disturb the symmetry and position.

WRYNECK—(TORTICOLLIS).

This deformity is commonly of congenital origin, and consists of a permanent contraction of either of the sterno-mastoid muscles. I have seen but two instances of contraction of both those muscles, but had reason to believe them to be acquired by resp. inflammation of the cellular and muscular structures themselves, and that of the cervical portion of the spine. The latter, observed in a boy of fourteen years, the spondylitis had entirely subsided, but the consecutive muscular retraction had remained. In one case the scaleni muscles on one side were concerned in the deformity, and the sterno-mastoid muscle free from contraction. And in quite a number of cases only the clavicular portion of the latter was implicated.

In the ordinary species of torticollis we have therefore to look upon the contraction of a single sterno-mastoid muscle as the proximate cause of the trouble, but know very little about its remote causation.

From analogy we may infer that morbid centrifugal innerva-

tion lies at the bottom, and we find therefore simultaneously other symptoms of kindred nature, as for instance congenital strabismus, and the characteristic attenuation to the extent of the nervous province concerned.

In high-graded cases of torticollis the deformity is very considerable, and extends to the spine and the thorax.

The little girl which I operated upon in your presence to-day,

FIG. 44.

cannot be set down as an aggravated case. She was too young for that. It is with torticollis as with club-foot, age renders them worse. The diagram (Fig. 44) represents a further advanced state of wryneck, and you notice its effects upon the frame.

First, it may be seen that the points of insertion of the right sterno-mastoid muscle approximate each other, and its tensity is exhibited by the prominence of its attenuated belly. The right side of the head is thereby drawn forward and toward the shoulder. The face is turned left, and the chin stands above the left side of the thorax. The right side of the face and neck is obviously atrophied, and the line of the palpebral margins slanting from the left to the right. The thorax seems to be, and actually is

twisted on its axis from left to right, and lifted upward. If you fix the thorax of such a patient, and attempt to turn the head in the opposite direction, the contracted muscle becomes still more prominent, and the patient experiences keen pains. And on the other hand, if the patient occupies the recumbent position, and the head is suffered to be placed on a level with the trunk, the thorax is drawn up and to the right, causing considerable and often so intense pain as to disturb the rest of the patient. In this way, I presume, the torsion of the thorax is effected, and in order to obviate this aggravation, the head should be well supported during sleep, so as to relax the retracted muscle.

In viewing the same patient posteriorly (Fig. 45), you can

FIG. 45.

readily observe that the spine has assumed a serpentine line, being laterally convex on the left of the cervical, on the right of the thoracic, and not seldom again convex on the left of the lumbar portion of the spine. Sometimes there is but a single lateral curvature, comprising the two upper thirds of the entire spine, with corresponding elevation of the scapula and ribs of the convex side. These indeed inevitable deviations of the spine and the thorax disappear with the wryneck, and thus demonstrate again

the correctness of our former observation, viz.: that a specifically mechanical disturbance of the centre of gravity cannot exercise any lasting effects upon the perpendicular of the spine.

The essential symptoms of wryneck are about the same, whether occasioned by contraction of the sterno-mastoid or one or the other of the scaleni muscles. From a comparison of the relative power and leverage of those muscles, it is obvious that the degree of torticollis must be greater when the sterno-mastoid muscle is the seat of the difficulty.

As a usual thing, wryneck is both congenital and permanent. This rule is, however, not without its exception. Inflammation of one of the sterno-mastoids, or any other of the rotatory and flexor muscles of the head, will, at least temporarily, give rise to symptomatic torticollis; and affections of the cervical portions of the spinal cord are occasionally ushered in by the same symptoms. I mention those instances merely as points of theoretical interest; but inasmuch as their treatment lies in a very different direction from the ordinary form of wryneck, I do not intend to occupy your time at this juncture. If both sterno-mastoids, or the scaleni muscles on both sides, are shortened, the head is of course directly inclined. That deformity cannot be properly termed torticollis, nor double wryneck, as has been suggested. Inclination of the head would seem preferable.

The *prognosis* of common torticollis is favorable. Ever since the introduction of tenotomy, that deformity has been manageable. Nor are the consecutive effects of torticollis formidable obstacles to perfect restoration of the normal form; at least I have not found them so in my practice. In advanced cases of long standing, the spinal deformity may possibly have become so rigid as to admit of no material amelioration; but such instances are exceptions from the prevailing rule.

The *treatment* of wryneck is either mechanical or operative, or both conjointly.

The mechanical treatment is admitted only in very slight cases of torticollis; it requires a long time to accomplish but little, and is generally too inefficient to be exclusively relied upon. Yet I have succeeded in two cases, and in a third that is now under my charge I hope likewise to succeed. The last I take occasion to exhibit to you. You perceive that the head of the

little patient deviates but moderately, and that with some aid we have no difficulty to give it its normal position. But that habit has nothing to do with the existing deformity, can be readily demonstrated by the retraction of the right sterno-mastoid muscle, being well marked, though not a very powerful one. Moreover, her parents assured me that the deformity has been observable since her earliest infancy. And since there are no local conditions to account for the trouble, I may safely assume its congenital origin.

Previous to the introduction of tenotomy, when mechanical contrivances had to be exclusively relied on in the treatment of torticollis, many contrivances were suggested to meet the exigency. The needed mechanical assistance is, however, so simple, that we may safely dispense with the old harness. Thus, for instance, if you intend to apply extension, you may use an ordinary bed in the place of the costly orthopædic one. Stout adhesive plaster may be chosen in the place of leather belts and straps, and India-rubber rings take the place of steel springs.

By a well-fitting belt fastened to the bedstead, the counter-extension may be effected; the head drawn in the opposite direction by an appropriately cut and applied strip of stout adhesive plaster, and affixed by means of India-rubber to a hook. That constitutes all your requirements.

But if you propose extension while the patient sits on a chair, you have to fasten a rod of well-tempered iron to the back of the chair, bending like a helmet over the head of the patient, to which the plaster may be attached as to the bedhook. Or a similar contrivance may be joined to an ordinary dorsal supporter for posterior curvature of the spine, which would enable the patient to indulge in any posture he likes, inclusive of locomotion. I have, however, rarely resorted to those means even, inasmuch as a high and stiff leather necktie, as Dieffenbach usually preferred, answered every purpose.

In finding the retraction too obstinate for extension, tenotomy is next in order. Practitioners not well acquainted with the help derived from position of the patient and efficient assistance, evince a good deal of timorousness when called upon to divide the sterno-mastoid muscle. Indeed, the anatomical importance of the parts located near the field of the operative proceeding, and

the apprehended danger of their injury, is quite enough to give tremor to the inexperienced hand. But, gentlemen, there is no real danger if you proceed with proper caution, and observe the advice I have offered repeatedly, viz.: *to raise the contracted muscle from its subjacent parts by proper extension.* When you last witnessed the operation at our clinic, you will remember that I directed one of the assistants to fix the thorax well by placing his hands over the latter in such a manner as to embrace the shoulders, resisting at the same time the pull at the head; whereas, the second assistant had to draw the head, and likewise to rotate it against the action of the retracted muscle. In doing so the muscle presented itself as a strong and tense cord, which could be easily circumvented by the finger. Thus you isolate the muscle, and you meet with no obstacle in passing a straight and blunt-pointed tenotome behind its tendon. You observe, therefore, that the safety of the operation depends on the tension of the muscle, and *vice versâ.* And inasmuch as the sterno-mastoid muscle is not bound down by rigid fascial structure, as some others, its division can be usually rendered more safe than many other muscles in close proximity of vessels and nerves.

There is no objection to administering chloroform to the patient preparatory to the operation. But it sometimes happens that anæsthesia diminishes the retraction of the muscle and thus obscures its contours. In such case I suggest the performance of the operation without it, or I would first try mechanical means, inasmuch as the relaxation of the muscle under chloroform indicates that it has not as yet entirely lost its expansibility. I shall, however, return to this point.

The patient should be horizontally placed on a table, and the head brought in a position similar to that observed in tracheotomy. After the assistants have assumed their respective positions, you insert a pointed tenotome through skin and fascia and withdraw it. Next you introduce the blunt-pointed knife. In using the same like a probe, you see that it passes through the punctured wound. You feel then the external margin of the muscle, and pass behind it sufficiently far to circumvent the clavicular portion; then you turn the cutting edge toward the tendon and divide it from within to without. If the deformity yields to redoubled extension, and you succeed in placing the

head in proper position, the operation is finished; if not, you have to advance with the knife behind the sternal portion, and divide that also in the same manner. From this description of the proceeding, you notice that I enter the structures at the outside of the muscle, and you have accordingly to take your place. In dividing the left sterno-mastoid muscle you stand on the right and before the patient; for the other, you have to assume your place at the head, unless you can use with the same dexterity your left hand, in which case the former position may be retained. As to the proper place of division, it seems immaterial whether you sever the tendon nearer or more remote from its insertion. I choose the place where the tendon, when properly tensified, is best isolated, and hence most easily accessible. Again, if you anticipate the necessity of dividing both insertions, it may be prudent to choose a long-bladed tenotome, so as to obviate a new entrance nearer to the sternal end.

The after-treatment is plain, and comprises the use of the means previously alluded to. A stiff necktie is mostly all that we employ in our practice, and we have had fair success with the same.

As to the division of the scaleni or other more deeply-seated muscles of the neck, we shall have another opportunity for discussion.

Some of the casual deformities of the cervical region are of a spastic character, periodical in their appearance, limited in extent, troublesome in duration, and scarcely amenable to any other than surgical treatment. I have seen but a few cases of that description, but, judging from the numerous records of like cases, I entertain no doubt as to their frequency.

Their causation is mostly obscure. Sometimes direct injury upon the cervical portion of the spine by fall or blow, or a previous concussion of the spinal cord, may be charged with being the cause of the trouble. In others we may discover hyperæsthesia of the same organ, but whether this be the cause or the result we are often at a loss to determine. In exceptional instances a prior choreal affection in childhood has continued to later years. Mental effects, the repeated sights of epileptic patients, and hysteria, are likewise suspected as remote causes. And, still oftener, no cause at all can be assigned.

Much is thus left to speculation and chance. All authors agree in the observation, that but little or nothing can be achieved by the most diversified medicinal treatment; whether this be from the intricacy of the cases, the obscurity of their causation, or their habitual character, we feel not prepared to determine. On the other hand, the orthopædic knife has, in many cases, been found a serviceable, and in some the only remedy. Hence a new field has been opened to orthopædic exploits, and to a certain extent that field has been successfully broken. In order to maintain the rising credit of tenotomy and myotomy in this class of ailments, we should strictly qualify its indications. I believe that the operation should be reserved for old cases, and those in which but the superficial stratum of the cervical muscles is implicated. It would be unwise to resort to operative measures in recent troubles of this kind, and before the spasm has become stereotypical; for mild remedies may suffice, or the spasm may yet change from one group to another.

Why the deeper muscular strata should be precluded from the use of the knife is self-evident.

The diagnosis, although generally easy, may occasionally be difficult with reference to the exact seat and extent of the clonic spasms, more especially when the deeper muscular strata are involved. For it is a well-known fact that the affection does not always display the same degree of violence in different muscles, nay, even in the different parts of one and the same muscle. Thus the more intense spastic contraction of one muscle would naturally obscure that of another less agitated one. And again, the spasm successfully overcome by the knife in one muscle may soon reappear in another. All these circumstances should teach us precaution as to the prognosis.

Inasmuch as I have already acquainted you with the method of performing tenotomy and myotomy, I shall lose no time at this juncture with superfluous repetitions. A surgeon who is not capable of appropriating principles or technical maxims in new exigencies without somebody else doing it for him, is scarcely fit for that responsible position. But, that you may fully understand the sort of cases I have in view in our discourse, and their management, I propose briefly to sketch some in illustration.

1. In April, 1836, Stromeyer took charge of the case of a lady, then some thirty years of age. As a child she had enjoyed good health. During infancy she had been a casual witness of the acquired epileptic paroxysms of her brother. But for a short period she had been affected with eczema of the hands. Later, her nervous system had exhibited an increasing excitability, without giving her however any serious trouble. About seven years previously, the patient was noticed to incline her head toward the shoulder, which was, however, set down as affectation. In the spring of 1835 the patient experienced a sudden fright, and from that time the spasms became more apparent, and gradually increased in vehemence. When Stromeyer first saw her, he found her in a reclining position on a sofa, the head being carefully supported by pillows. On rising, the distortions became manifest. The head was, with sudden jerks, pulled towards the left shoulder, so as almost to touch it, whereas the face was turned to the right, so that the left ear came almost in contact with the sternum. The left side of the face became distorted, the left eyeball protruded, and the countenance manifested the expression of terror. In a few seconds the spasms subsided, and the head could be borne erect, in order to return again with the same vehemence, in about the same space of time. While the spasms lasted, it could be clearly discerned that they were located in the sterno-mastoid muscle, which shortened to the half of its length, and projected with its contours accordingly. Mental excitement and local irritation would augment the ephemeral contractions, whereas extension would diminish or even prevent them, though causing painful sensations along the affected muscle. During sleep, the spasm became quiescent.

Although for a year forced to a reclining position, and deprived of out-door exercises, yet her general health had suffered but little. Her nervous system exhibited, of course, that excitability which is usually coupled with such troubles. The patient had been subject to various medicinal treatment, the use of mineral waters, etc., but she had derived not the smallest amelioration therefrom.

On the 26th of April, Stromeyer subcutaneously divided the sternal portion of the affected muscle, in which the spasm seemed

to be centred. The momentary relief was most striking. The spasm at once subsided, and the patient could easily control the position of the head. Nevertheless, and in spite of subsequent extension by an appropriate apparatus, the spasms recurred in the undivided portion of that muscle. On the 26th of May, the sternal extremity was likewise divided. The patient, now quite relieved, went into the country "rejoicing," and took Driburg Spa as an after-treatment. In September she returned, with new spastic agitation at the cervical region, in which however the reunited sterno-mastoid muscle took no part. The examination disclosed the clavicular portion of the trapezius muscle concerned in the automatic movements. The division of that stratum removed the last vestige of the trouble.

For a similar affliction of a merchant, Bujalsky, in St. Petersburg, I excised pieces out of the two external branches of the accessory nerve, with but temporary relief.

Amussat's case (*Gazette Médicale*, December, 1834, No. 5) presents great similarity with that of Stromeyer. The case had been of six years' duration, and the affected sterno-mastoid muscle had become substantially hypertrophied, when the author divided the same. The result was instantaneous and lasting.

One of my cases occurred in a justice, fifty-five years old. The clonic spasms of both trapezius muscles had existed for three years when I took charge of it. Its cause was doubtful; whether from rheumatism, or the removal of a lipoma from the right supra-scapular region, or any other cause, could not be satisfactorily determined. The general health of the patient had not suffered. The spasms had once ceased during an attack of typhoid, but recurred with convalescence. They became likewise suspended while the patient was asleep. All sorts of treatment had been vainly tried. The subcutaneous division of the affected muscles afforded permanent relief.

The other case comprised the right cervical muscles in a middle-aged gentleman, and was likewise of several years' duration. A fall with the cervical region upon a projecting substance had evidently been the cause of the affliction. The spastic movements of his head were twofold—rotatory toward the left, and strongly inclining toward his right shoulder. They seemed to emanate from the right sterno-mastoid and platysma-myoides

muscles. But the division of them brought but an indifferent amelioration, on account of the deeper muscular strata being likewise involved. Thereupon I proceeded to divide the scaleni muscles, which were the most tense under extension. I commenced the operation by a three-inch-long incision at the external margin of the sterno-mastoid muscle, and near its thoracic insertion. Having divided the fascia in the usual way, I cautiously dissected the subjacent connective tissue and fat, employing scissors, director, and scalpel handle in preference to the knife. Thus I approximated the scalenus anticus, which presented its contours in the base of the wound. Next I isolated that muscle behind, placing it upon the director, and dividing it half an inch above the passing subclavian artery. Becoming, however, convinced that the deeper cervical muscles took part in the spastic distortions, my operation rested there and then. The wound gave no trouble; no hemorrhage attended the proceeding. The patient was by no means cured, but so materially benefited that I had no cause to regret the operative attempt. As far as I have been able to trace the patient's whereabouts, I have ascertained that the violence of the spasm has been effectually broken, and that he is now able to control the remaining inconvenience by a stiff necktie made of leather.

CHAPTER IX.

IDIOPATHIC DEFORMITIES OF THE KNEE.

IRRESPECTIVE of those deformities of the knee-joint which occur in connection with articular diseases and paralytic affections, which will be considered in their appropriate places, we meet with deformities of that articulation which are of a strictly local and mechanical origin. They may be considered under three different heads, as genu valgum, varum, and recurvatum.

I.

Genu valgum, or *knock-knee*, is that deformity of the knee in which the tibia forms with the femur a more or less conspicuous angle, opened at the exterior of the affected extremity; or in other words, in which the tibia occupies a more or less abducted position with the thigh.

The deformity is commonly complicated with talipes valgus. Sometimes the latter appears as the preëxisting impediment, knock-knee having been superadded in time. At others, both are the result of the same mechanical cause. And in some cases talipes valgus is the undeniable effect of genu valgum.

The distortion may be of congenital and acquired origin. Whether the crooked position of the fœtus during gestation is in itself a sufficient explanation of congenital knock-knee is as yet undecided, but strongly suspected when no other direct cause can be assigned.

Among the known causes of this deformity, rachitis is adduced. In the rickety genu valgum, certain anatomical changes of the knee-joint are inseparable, to wit: infraction of the lower extremity of the femur; enlargement of the internal, and corresponding diminution of the external condyles of both articulating bones; the articular cartilages at the external condyles are generally rarefied, and the subjacent bone eburnated.

From the same cause (usur) we find osteophytes at the external circumference of the joint. In high-graded genu valgum, from rachitic causation, the internal lateral ligaments of the knee-joint may become so irritated as to engender inflammation of the synovial membrane, and create a succession of new troubles.

Knock-knee occasioned by talipes valgus corresponds in degree with the latter. It is this species of the deformity with which we frequently meet on this side of the Atlantic, and especially among young people, who perform their work standing, who carry and lift heavy parcels, and who use their knee-joint in lateral motion while treading bellows. Hence porters, grocery-clerks, bakers, and locksmiths furnish the largest contingent of patients. Usually but one extremity is thus afflicted; exceptionally both suffer from the deformity, of which we had but lately an instance at our clinique (Fig. 46).

It has been suggested that the proximate cause of this class of knock-knee depends on an arrest of development of the external condyles of both the femur and tibia, and on overgrowth of the internal ones of these bones. I am, however, of opinion that these changes in the articular faces of the knee-joint, especially in old cases, are more the effects than the causes. For the articulation in knock-knee is rather loose and weak; it is not exclusively laterally incurvated, but both incurvated and longitudinally rotated; it is gradually superadded to preëxisting talipes valgus, and mostly remedied with that deformity. It is acquired by overtasking the joint with too heavy weights at a time when it is still weak, and in general it can be relieved by mechanical means, exercising no direct influence upon the shape of the bones, excluding of course the rachitic species of the deformity.

A careful examination of the trouble, under a proper degree of extension and counter-extension of the extremity, will disclose, as the direct cause of knock-knee, a marked contraction of the external duplicature of the vagina femoris inserting at the capitalum fibulæ, and occasionally a contraction of the biceps femoris muscle. We are somewhat at a loss to account for these shortenings, unless we have to recognize in them reflections from preceding inflammatory irritations of the joint by the malposition, which indeed I have repeatedly observed, terminating in fibrous anchylosis.

To enter upon the symptomatology of the deformity, and to qualify its impediment in locomotion, seems superfluous, since you meet cases of the kind in the streets almost every day. I have often heard the opinion expressed, that this malposition will be outgrown, or, in other words, spontaneously corrected. This is a serious error. We should lose no time in mending the deformity. In waiting, we allow the originally moderate malposition to advance to a formidable difficulty, in which gradually the articular surfaces may participate and render the case incurable.

The treatment of knock-knee presents little difficulty. Divide the duplicature of the fascia lata right above the joint, and if necessary divide also the tendon of the external hamstring. Allow a few days to elapse after the operation, until the wounds have healed. Then apply a well-padded splint of sheet-iron externally to the extremity, and bandage it tightly up, particularly at the knee. You may combine with the splint longitudinal extension by pulley and weight, or use weights both longitudinally and transversely at the knee. The latter treatment I employed in the last case, and you are aware of the perfect relief of the deformity (Fig. 47). Of course you have to protect the patient against a return of his difficulty by leather splints, stiffening bandages impregnated with plaster-of-Paris, dextrine, by invigorating lotions, passive exercises, and so forth. Above all, the patient should abstain for some considerable time from lifting and carrying heavy weights, and had better change his occupation.

With reference to the purely mechanical treatment, lately so strongly urged by its advocates, Dr. Henry Dick, of the National Orthopædic Hospital, London, so completely expresses my views that I may be permitted to quote his remarks* in full:

"You have no doubt heard or read something of the *cutting* and *non-cutting* of tendons, in the treatment of deformities. Make it always a principle in practice to try a thing (of course if there is no danger in doing so); so I tried the non-cutting method for three months. There was a little improvement in both knees, but the deformity in the right knee was still persisting. I dare say, *in a very considerable length of time* I should have cured the patient.

* Canada Medical Journal. Vol. iv., No 5

"As the non-cutting method did not seem very beneficial, I decided to cut the biceps and fascia in the right leg. You see the result. Only three weeks after the operation was performed, the deformity in the right leg had entirely disappeared. You see the leg upon which the operation has been performed presents a much more normal shape than the other, upon which no operation was performed. I was always of the opinion that the subcutaneous cutting of tendons is a very harmless operation; of course if practised where not indicated, and in the wrong place, it will do harm. But the same may be said of all remedies and operative proceedings. Wherever there is an idiopathic shortening of soft parts, and no cause any longer existing in the nervous centres, I think subcutaneous section is of very great advantage. In fact, all our improvements in the treatment of deformities must be ascribed to it. Our forefathers tried to cure deformities by buckling, strapping, and straightening; but very little improvement was made in the right direction. Before tenotomy became popular, there were numbers of orthopædic institutions to be found everywhere, but the result of their treatment was not satisfactory, until subcutaneous section was tried.

"The rachitic species of genu valgum is subject to the same treatment as the rachitic distortions of bones in general, which will be referred to in connection with the subject.

"Sometimes you may meet with most extraordinary cases of knock-knee from a very different causation."

Case 8. Traumatic diastasis of the lower epiphysis of left femur.—Remarkable deformity and malposition of the knee-joint (knock-knee).—Abnormal lateral mobility.—Total resection.—Recovery.—Francis Shaw, a lad of fourteen years, of Irish descent, and endowed with robust health, presented himself in October, 1860, at the clinic of the Brooklyn Medical and Surgical Institute. He came at the instigation of a surgical instrument maker to get my advice with reference to the feasibility of a mechanical apparatus to steady and support his limb, and to render it useful for locomotion. He stated that he had acquired the deformity when but seven years old, and that ever since the trouble had increased, and that then he was unable to use his extremity to any purpose. To the best of his memory, he received a blow at the knee-joint

with an iron rod, which gave him pain, and disabled him for a short time. A physician had been called in soon after the injury, but finding no undue mobility or deformity, he pronounced it a simple contusion, and advised rest and cold fomentations. These directions were followed for three weeks, when the patient resumed his walk.

Since that time dates the impediment. In the erect posture, the patient throws his whole weight upon the sound member; when balanced between two chairs a three inch-block is required to equalize the length of both extremities, as may be seen in the adjoining diagram (Fig. 48). The left limb is peculiarly knock-

FIG. 48.

kneed, the thigh being adducted, the leg abducted and everted, and laterally both forming an angle of 120°. This position alone would have been quite sufficient to render locomotion

infirm and defective, but as it was, the limb became totally useless by the relaxation of the knee-joint. At the moment the patient rested upon the affected extremity, the leg became still more abducted and everted, and the angle with the thigh could easily be reduced to 80° and less. Both articular faces moved with undue freedom over each other, and the tibia could be freely rotated upon the femur, the scope of eversion being, however, greater. This abnormal condition was due to some remarkable anatomical changes in the configuration of the joint. The articular surface of the femur had an oblique direction, from below and inward, to up and outward; the two condyles were absent, and the bone terminated below as a segment of a sphere, of which but a part was appropriated for articulating purposes; the patella and the quadriceps muscle were drawn out of position toward the outer aspect of the extremity. The tendon of the biceps muscle occupied the popliteal space. In every other respect the limb presented the ordinary condition, except being slightly attenuated.

Before the patient had applied to our institution he had presented himself before the surgical staff of the New York City Hospital, who had come to the conclusion to advise mechanical support, which was, however, entirely out of the question. On the other hand, Francis Shaw had arrived at an age which made him desirous of entering upon some business, and therefore insisted upon some means to render his limb serviceable. There was nothing left but the exsection of the knee-joint or amputation of the thigh; for no orthopædic treatment could be relied upon to materially alter the anatomical status.

I could not hesitate to decide in favor of exsection, since both the constitution of the lad, as well as the bony structure concerned, were in a most auspicious condition. The operation was performed on the 9th of October. I had to remove quite a large piece from the femur, so as to obtain a rectangular surface; but a very thin slice was taken from the tibia; the patella was likewise removed. The bones were then brought in close proximity and kept in position by softened iron wire, and the wound united by silver wire; in fine, the limb was secured in one of the iron splints (vide Fig. 66), which left the knee-joint itself free of access. Recovery followed rapidly, partly by

first intention. The bone-wire was removed on the twenty-sixth day after the operation, and at the end of the second month the patient was up and about, and accompanied me on crutches to a neighboring gallery to have his photograph taken. Represented in Fig. 49.

FIG. 49.

On the 28th Feb., 1861, I exhibited Francis Shaw at the New York Pathological Society, when his conditions were as follows: integuments, completely cicatrized; firm union of the bones by short fibrous tissues admitting but of scanty motion; moderate enlargement of the circumference; circulation and temperature normal; deficiency in length two inches; correct position of the foot. With a heel of two and a quarter inches, pelvis and shoulders stand square. His locomotion was, aside from the stiffness of his knee, unimpeded.

You may imagine that the diagnosis of the case must have been perplexing, when the most distinguished surgeons of New York signally fail to realize it, nor could I lay any claim to a clear understanding of the proximate cause in the premises before the operation; yet I have the gratification to say that the views I had first formed and expressed to my class did not fall short of the reality.

That the injury to Francis Shaw had produced no fracture was self-evident from the previous history, so clearly related. Nevertheless the continuity of the femur must have suffered in such a manner as not to disturb the form of the limb, nor give rise to any undue mobility. With diastasis of the lower femoral epiphysis these conditions are compatible. Had the patient quietly remained in bed for six or eight weeks, there is no doubt that the subsequent trouble would have been averted. But in

rising prematurely, the soft agglutination of the epiphysis with the shaft gave way, and allowed the former to turn gradually round, and with it dislodge the entire joint. In the newly acquired position the undue pressure upon the external condyle of the femur had gradually diminished its size until no trace was

FIG. 50.

FIG. 51.

left; and the internal condyle became the terminating end of the femur. The fragments of bone removed by the operation (Fig. 50 and 51 *) render this reasoning at least plausible, if not conclusive.

II.

Genu varum, or bow-leg, is essentially a rachitic affection, and consists in the excurvation of femur, tibia, and fibula.

As to the treatment of this unsightly deformity, I must refer you to another part of our lecture.

III.

Genu recurvatum is undisputably the rarest of all deformities appertaining to the knee-joint. As a collateral impediment, it may be observed in talipes varus and equinus, more particularly then, when the heel stands within a small distance from the floor, and may be brought down by bending the knee back-

* a. Epiphyseal line; b. Internal condyle of femur; c. Slice of tibia. The deeper shaded part of the diagram represents the specimen removed. The bones of the leg are indicated by simple lines, in order to exemplify the malposition of the tibia In doing so the artist has committed an anatomical mistake, which escaped my notice at a time when it might have been corrected. The tibia should occupy the opposite position.

wards. It is likewise associated with paralysis of the lower extremity, in connection with which I shall reconsider the symptoms on a future occasion.

Idiopathic genu recurvatum happens incidentally after penetrating wounds of the knee-joint, and appears during the time of anchylosing, more particularly when the rest of the joint is not well secured by mechanical means. As far as I know, there are but two cases of this kind on record. The one is by Wm. Adams, Esq., London, the other by Dr. T. E. Grant, of Ottawa City, Canada. By the courtesy of the latter gentleman, I am enabled to familiarize you with both the history of Dr. Grant's case, and with the pathological specimen, of which I submit a cast.

Case 9. *Penetrating wound of left knee-joint.—Recovery.—Brisement forcé through a fall.—Eventual bony anchylosis with incurvation of the affected extremity.*—My friend Grant took charge of the case at a very late period, about seven years after the accident.

From the statement of the patient, a lad of eighteen years, and of excellent and robust constitution, it appears that he suffered an injury to his left knee-joint when about eleven years of age, in striking himself with an axe. The femur was grazed above the inner condyle, and the joint opened thereby, for very soon synovia escaped from the wound. When, after four days' delay, a physician was called in, the articulation was greatly distended, hot, and tender; the extremity semiflexed, and the patient very feverish. The application of leeches and warm fomentation to the joint, the securing of a straight position to the affected member by Liston's splint, and the occasional administration of purgatives, speedily allayed the patient's suffering. At the tenth week he returned home, supported by crutches, and soon after was able to move about without any inconvenience to the joint. Up to the eighteenth month the extremity remained perfectly straight, retaining a slight mobility. At about that time the support of the knee-joint seems to have been removed. Apparently a few months later, the patient met with a fall, which gave him "much pain" for several days. Soon after his father observed the growing "angularity" of the extremity, which was however allowed to go on, until it had

reached the extent which it presented on the 17th of May, 1861, when the patient was received into the General Hospital of Ottawa City, and placed under the charge of Dr. Grant.

The leg occupied then a rectangular position to the femur; the knee-joint was entirely obliterated by "ossific deposits," and had of course lost all mobility. Locomotion was very awkward. In order to bring the affected extremity to the ground he had to place it backward, and its fellow in a rectangular flexion forward; both limbs formed then with the floor a regular square. In sitting on a chair the limb stood vertical. Very properly the doctor advised the excision of a wedge-shaped piece of bone, which in all probability would have resulted in a straight and useful extremity; but the parties concerned insisted on amputation, which was eventually performed with reluctance. The wound closed at the end of the fourth week.

The specimen has been sent to the museum of St. Bartholomew's, London. The cast exhibited here is an accurate copy, made of plaster of Paris (Fig. 52). The doctor states that the surrounding structures of the articulation were perfectly healthy. The ligamentous apparatus had been displaced by "ossific deposits." The anterior surface of the femoral condyles closely united with the anterior part of the articular surface of the tibia. Posteriorly, the gap between the two bones is filled up with massive osseous material, by which the dimensions of the joint are increased. The patella has been dislodged to the outside of the external condyle of the femur, and agglutinated in that situation by osteophytic growth.

Fig. 52.

There can be no two opinions as to the cause of the second trouble. The traumatic inflammation of the joint had evidently reached a favorable termination in fibrous anchylosis. Most probably the injury to the femur and its periosteum had established some disposition to hyperostosis, but the constant use of the affected extremity had effectually prevented the osseous

union of the articulating bones. The fall broke up the existing interarticular connections, and not unlikely had the effect of giving to the loosened joint the posterior direction. Reaction, of course, followed the injury, and resulted at last in the bony union and distorsion. I do, indeed, not know how to account for the dislocation of the patella, unless it was directly effected by the fall. The case was particularly well qualified to Rhea-Barton's operation—and I can well imagine the vexation of Dr. Grant, when he felt himself impelled to amputate against his better judgment.

Some time ago I attended a lad of seventeen years for a penetrating wound in front and above the knee-joint. When I took charge of his case the joint was distended with pus, which I relieved by proportionate free incisions. Thenceforth the granulation of the articulation took its steady course, and terminated in complete obliteration of the latter, compromising at the same time the subcrurean bursa and the play of the quadriceps muscle of the thigh. On dismissing the patient I advised the use of crutches, whilst the joint was firmly sustained by a plaster-of-Paris bandage, which I intended to exchange for a suitable instrument. But he did not come near me for several months after, and when I met him incidentally in the street I noticed a marked recurvation of the knee-joint, which has since materially increased. Having failed in procuring the compliance of the patient to correct the deformity, I apprehend that the steady increase of it will eventually furnish a simile to Dr. Grant's case.

The cause of this deformity is clear. The only means to counteract recurvation of the joint rests with the quadriceps muscle, patella, and its ligament. None of these are in active operation; the former being bound down by the adhesive obliteration of the subcrurean bursa; the patella immovably adhering to the femur, and ligamentum patellæ comprised in the sclerotic tissue which pervades the periarticular structures.

CHAPTER X.

PARALYSIS.—PALSY.

GENTLEMEN:—By this rather conventional term quite a variety of diseases is implied. Paralysis is as much a common symptom of them, as dropsy is in diversified affections of the heart, the liver, and kidneys.

The loss of motor power and sensation is inseparable from structural lesions or mechanical defects of the nervous system. A mere functional suspension of nervous force, induced by a remote morbid action through the agency of the spinal cord (reflex paralysis), is, in my humble opinion, a mere hypothetical assumption.

However, it is not the mission of orthopædic surgery to extend its researches into the physiological and pathological subtleties of the nervous system, to grapple with theories of an entirely abstract character, and to settle questions which do not directly affect its legitimate domain.

We have to take cognizance of paralysis only in so far as it gives rise to distortions of the body and to impediments of locomotion, being at the same time susceptible to orthopædic treatment.

But exceptionally come the paralytic affections of adults within the scope of this specialty. Paralysis, originating in lesions of the brain, is generally unchangeable; eventually, it can be reached only by the amelioration of the cerebral disease. In paraplegia caused by traumatic injuries or by apoplectic clots, occasionally we may profitably employ orthopædic remedies, and thereby improve and facilitate the usefulness of the lower extremities.

It is, however, chiefly in the paralysis of children in which the orthopædic surgeon finds a large field of useful employment and clinical interest. In comparing the clinical character of

infantile paralysis with the same affection of adults, one canno[t] fail in observing material differences.

About its pathology but little is known. There can be no question, however, as to its central origin: but so great is the adaptitude of the infantile skull and spine as to provide for its own relief. At any rate, the same central lesion that would [illegible] in adults, terminates usually in comparatively moderate [illegible] with self-improving tendencies. Muscular [illegible] more frequently noticed in the [illegible] than in grown people, and the most [illegible] view, particularly [illegible]

[illegible] infantile paralysis [illegible] of the spinal cord. [illegible] cases of hemiplegia [illegible] the [illegible] paralysis in infants can be no [illegible] may be [illegible] leaving as [illegible] foundation. [illegible] essential [illegible]

[illegible]

[illegible] the rule of the distinguished French writer is [illegible] not free from exceptions: [illegible] in which the susceptibilities of the [illegible] muscles to the electric current were directly reversed. [illegible] the permanence of essential paralysis is extremely [illegible] gradually some of the paralysed muscles recover their nor[mal] [illegible] and in most instances but the contractions alone re[main] [illegible] the whole trouble.

[illegible] is equally unfounded that the bladder and rectum are ex-

empt, as Niemeyer states. In two patients of mine, suffering from paraplegia, the control of both organs had been completely lost. One of them, a girl of nine years, had been in charge of Duchenne; he is therefore in the position of verifying my statement.

Essential paralysis is eminently an affection of infancy, and happens more often at the time of teething.

As remote causes, are designated eruptive fevers and cold; a few cases I could trace to perverse constipation of the bowels, and whooping cough. Often no cause at all can be determined upon.

Atrophy, arrest of growth and development, diminution of temperature, looseness of the articular apparatus, and loss of electric contractility of the paralyzed muscles, are the ordinary concomitants of essential paralysis. The so affected extremities are subject to decubitus, to be frost-bitten, and to superficial ulceration, particularly around the nails. Through the contraction of muscles all sorts of deformities are induced. The more prevalent are the club-hand contraction of the flexors; undue pronation of the forearm; contraction of pronator teres; talipes equinus and valgus; but exceptionally, talipes varus; the knee is strongly flexed upon the femur; the thigh upon the pelvis; when the adductors of the former are contracted, the limbs cross. In fact, it is almost impossible to exhaust the calendar of these distortions.

Some years ago a boy was brought to me who presented all these deformities collectively, and who was therefore unable to use any of his extremities. He represented a veritable bundle placed in the corner of my office.

The general health of these patients is rarely impaired; their vital functions are mostly in the best of order, their intellect good. In a considerable number of cases there were but two whose mental powers were below par, including the boy before mentioned.

As already indicated, *the prognosis* is, on the whole, better than the complaint seems to warrant. Some patients get well spontaneously and in a very short time; in others the complaint becomes permanent, more particularly the deformity, and when eventually relieved, the afflicted extremity remains feeble, its growth impaired, and the implicated joints limber. Death from this source is never incurred.

Above all, the *orthopædic treatment* is generally attended with satisfactory result, and, if persisted in with all the means at our command, goes far in reëstablishing the motor powers, the normal form, and locomotion.

The *first indication* in the therapeutical management of essential paralysis, is the relief of the coexisting muscular contraction. As long as this is permitted to prevail, the deformity continues; locomotion remains impeded, the joints are acted on in misdirection of the motor power, and, worst of all, the contractions seem to exercise a prejudicial influence upon the nutrition and growth of the limb. For, as I have observed in many instances, both immediately improve as soon as the contractions are disposed of.

Thus we again confront one of the most important questions in orthopædic surgery, viz.: how to treat and to alleviate muscular contractions?

To this question two different answers have been rendered. Those who consider muscular contraction as a sort of permanent spasm, rely upon, and strongly recommend gradual extension by weights and elastic traction; those, on the other hand, who consider the muscular contraction as a *fait accompli*, and presume that in whatever condition the contracted muscle had been, the contraction itself proves organic changes in the muscular structure totally incompatible with muscular expansibility. The advocates of extension bring forward a formidable array of scientific authorities, experiments, and speculations, against which their opponents produce but a single clinical fact. Now it is possible that in recent cases of essential paralysis the contraction may be of a spastic character, and extension the sufficient remedy to subdue it; but it is equally true, and fully substantiated by clinical facts, that in the course of time the contracted muscles lose all expansibility, and assume the physical character of tendons. Fortunately, we possess in anæsthesia a valid test. In submitting the patient to it, we know from experience that spasms subside for the time being; that the spastically contracted muscle becomes flaccid, soft, and yielding to its full length, whilst the actually contracted muscle remains unaffected. This test, then, must be admitted as conclusive.

Having myself tried the expansibility of contracted muscles

by both gradual and forcible extension, the latter by the aid of anæsthesia, I hold myself competent to decide the question at issue.

I candidly confess to having succeeded in some recent cases of essential paralysis in elongating the contracted muscle, by force and anæsthesia. But as soon as the latter had subsided, the contraction returned. These cases seem to invite elastic extension, and I tried it faithfully and perseveringly, with all the means at my command, but I signally failed in accomplishing the object. Not one of my patients derived any benefit whatsoever from this mode of treatment.

Further, I have attended any number of cases in which extension of the most perfect kind had been employed, partly by the very advocates of this method, and eventually they had to submit to the tenotome to get rid of their respective deformities.

In some cases extension had engendered inconvenience, pain, and even dangerous symptoms, and therefore had to be abandoned. My experience has consequently not sustained the pretensions made in behalf of extension; I have therefore no hesitation in saying that I have done with it. Perhaps I have been unfortunate in the selection of my cases; but others seem to have been not more successful, and thus the conclusion is the same. I must leave it to you whether to accept or reject my experience in the matter, but do not entertain any doubt that in time you will meet with the same disappointment and discouragement which have attended my zealous efforts.

Of late the most favorable accounts have reached us from Europe, as to the efficacy of the constant galvanic current in relaxing contracted muscles. I have no experience myself of this remedy, and therefore hesitate to offer an opinion. But this much I know, that several cases of mine had been subjected to the galvanic battery without the slightest relief. One of them had been under charge of Jules Guérin and Duchenne, for months in succession, but she returned to this country in as bad a condition as she went. The division of the contracted muscles gave her permanent relief; within six months she obtained full control over both bladder and rectum; and at the end of the first year of the treatment she assumed locomotion, with the support

of a finger to balance her. And ever since her improvement has been steadily going on.

In my humble belief, the division of contracted muscles is indispensable to the effectual treatment of essential paralysis, extension being at best but an auxiliary.

As to the objections against tenotomy, I have expressed my views so explicitly on former occasions that I need not recur to them now. Suffice it to say, that I have divided most muscles of the extremities for orthopædic purposes, and I have had reasons to think them proper, beneficial, effective, and indispensable; nor have I met with any of those disasters which the advocates of extension imagine.

It is indeed astonishing how great a boon the division of a few muscles confers upon patients thus afflicted, and how grave inconveniences may arise from the contraction of a few muscles. A few years ago, one of our most distinguished medical practitioners intrusted me with the charge of his eldest son, who had for many years suffered from impediments of the right arm and leg, the ulterior results of essential paralysis. The division of the pronator teres, flexores carpi, and of the adductor pollicis brevis, restored the use of his right arm and hand; whilst the division of both the Achillis and tendon of tibialis posticus muscle completely removed the impediment of his right limb, eventually rendering him fit for military duty. Thus I could, if needed, enumerate a tolerably large number of equally successful cases, in which tenotomy was profitably employed.

It is not required to enter upon the special deformities accruing from this source, nor is it necessary to point out to you the single muscles requiring division. The advice which I have to offer you in this class of distortions is so well expressed by Doctor Henry Dick, of the National Orthopædic Hospital, that I can but fully endorse it: "Wherever there is an idiopathic shortening of soft parts, and no cause any longer existing in the nervous centres, I think subcutaneous section is of very great advantage."

The *second indication* in the treatment of essential paralysis is the invigoration of the paralyzed muscles. For this purpose various means commend themselves. Faradaism occupies the foremost rank in efficacy; it promotes nutrition, it maintains

the muscular structure, in brief, it is a substitute of volition. Next come stimulating lubrications with phosphorated oil, alcoholic washes, and the like. Passive exercises are of great therapeutic value; warm baths, the douche, are commendable. The rapid change of temperature may also be employed as a therapeutic agent. And last, though not least, the paralyzed members should be enveloped with and protected by woollen covering, so as to sustain the temperature, and to act by friction upon the surface.

Locomotion should be encouraged as much as possible, if necessary, by the aid of crutches.

These remedies conjointly will render relief in the most desperate cases, but they must be persistently employed to bring about the desired result. A year or two counts but little in the treatment of essential paralysis, and it is in this class of troubles in which everything depends on patience and continuous efforts.

Gradually the muscles evince some reactibility to the induced galvano-magnetic current, which in time increases to noticeable contractions; the muscular belly enlarges and assumes contours, the integument retains its temperature, and does not exhibit that mottled appearance when exposed to cold. The limb changes its shape with the development of muscular structure; nutrition is correspondingly promoted, and thenceforth it keeps pace in growth with its fellow.

If there are still symptoms indicative of central lesion, it is the duty of the attending surgeon to qualify their seat and nature, and treat them accordingly. After leeches to the tender spine, occasional aperients will be of service. Generally speaking, the central affections have subsided when the like cases are presented to the surgeon, and therefore medication is rarely called for.

In contemplating the diversified pathological conditions to which the central organs of the nervous system are susceptible, you will admit with me that medication is, at best, of problematic utility. Most all improvements in that sphere are attributable to spontaneous action; and it seems to be advisable to content one's self with the protection of the healing art of nature, and not to venture upon coercion. I have certainly tried the virtues of remedies, but I have been universally unsuccessful. Above all, I beg to warn you against the use of strychnine, and

I have reason to believe that it can do but harm. Its physiological relation to the motor columns of the spinal cord cannot serve as prototype, for in essential paralysis the conducting power of the implicated nervous structure is impeded or lost through organic changes, and cannot be reëstablished by any other process than reconstruction, and upon this strychnine can exercise no influence; whilst, on the other hand, it may diminish and even annihilate the motor force in the remaining normal structure of the spinal cord.

CHAPTER XI.

Progressive muscular atrophy.—Wasting palsy.—Atrophie musculaire.—Paralysie musculaire atrophique (Cruveilhier).—Atrophie musculaire avec transformation graisseuse (Duchenne).—Idiopathic degeneration of the voluntary muscles (W. Robert).

Our knowledge of this somewhat mysterious disease of the muscular system is of comparatively recent date, and the question as to its proximate cause is by no means settled. While some observers ascribe it to a degeneration of the anterior roots of the spinal nerves, and look upon the fatty degeneration of the muscular fibrillæ as mere consecutive effects, others claim for the latter idiopathic origin in the affected muscles themselves. The existing discrepancy of opinions on the subject is probably engendered by the confounding of two essentially different diseases, which, however, coincide in the progressive metamorphosis of the muscular structure. It is very evident that where the disease is initiated in the motor columns and roots of the spinal cord, motor paralysis must occupy the foreground of its clinical aspect, and the wasting of the muscle can be but set down as an ulterior result. In true progressive muscular atrophy, the excitability of the peripheral motor nerves, and of the muscles, remains as long as there is a vestige left to contract, and this physiological status is certainly incompatible with the claimed lesion of the nervous centres. Most authors have, therefore, agreed upon the idiopathic character of progressive muscular atrophy, and would rather accept the tectural lesions of the nervous system as secondary in effect. Of such a nature is evidently the case which Cruveilhier published in the "Archiv Général de Médecine, 1853;" and being perhaps the most selected prototype of the malady under discussion, I deem it proper to render a brief account of it.

The patient was thirty-two years of age, and a man of dissolute habits. In one of his debaucheries he passed the night in the street mud, September, 1848. On rising, he experienced some

numbness in his right side, upon which he had rested. The warm room of the next public-house soon restored both motion and sensation. Three weeks after the occurrence, he noticed weakness of the right hand, in not being able to take hold of objects. To this the lesion confined itself for a year. Having again passed a wet and cold night in the open air, he felt the same weakness in the lower extremities. From that time to July, 1850, when he came under Cruveilhier's charge, the lesion of the muscles had travelled over the members, the face and chest, and involved even deglutition and speech. Sufficient muscular powers had been left him to dress and to feed himself; he could yet intelligibly articulate. The affected muscles were occasionally agitated in the shape of "fibrillary quivering." The tactile sensibility was developed to its highest degree (hyperæsthesia); the senses were remarkably delicate, and his intelligence perfect. He had no pain, but his "strength was gone," and his "weakness increased daily." During another year, he had lost all locomotive power, was helpless as a baby, and had to be fed and put to bed. His saliva continually escaped. Deglutition was almost impossible, and could not be effected unless the food was thrust down into the pharynx. But even then repeated efforts were needed to get down the nutriment. Speech being totally lost, the patient had to communicate by the eyes, guttural and nasal sounds. The respiration was so very incomplete as to threaten asphyxia. Epidemic influenza terminated the patient's life on the 15th of January, 1853.

Autopsy.—Brain quite healthy; spinal cord sound, of usual bulk, consistence, and color. The anterior roots of the spinal nerves remarkably small, and at the cervical region reduced to the neurilemma. The muscles of the pelvis and thigh had escaped the atrophy, whereas the masticators, the muscle of the pharynx, of the supra and infra hyoidean regions, had undergone atrophy. Other muscles were emaciated and pale; most were in a state of atrophy and fatty degeneration. Not a single muscle of the upper extremities unaffected; the muscles of the hand had suffered most. The tongue had been reduced to a fatty mass.

Molecular changes of the muscular structure present themselves under two different circumstances, and in two different forms.

In more or less extensive destruction of the nervous centres,

muscular atrophy seems to be the ordinary concomitant, and the progress of the one seems to determine the other as to rapidity and extent. Rokitanski examined the muscles of a body in which central myelitis had engendered progressive atrophy. He found all muscles—preëminently, however, the psoas, glutæi, and trunk muscles—changed, *not in fat but in granular detritus*, in which the longitudinal striæ were well preserved; the transverse, however, but partly.* The color of these muscles was of a pinkish hue. There had been great tenderness of the muscles. The case terminated fatally in less than five weeks.

The genuine progressive muscular atrophy exhibits the characteristics of a fat metamorphosis, a conversion of the muscular fibrillæ into oil globules occupying the otherwise empty sarcolemma. The disease begins with the change of the natural color into buff; the fibrillæ become pale, the transverse striæ disappear, fat accumulates at some places and causes a varicose distention of the tubes; the latter collapse at a later period. Alongside of these so altered muscular fibrillæ are seen others almost normal.

Ever since Cruveilhier has called attention to the condition of nerve-centres, they have been the object of careful pathological research; but exceptionally they have been found involved.

The symptoms characterizing this singular complaint, are gradually but steadily increasing weakness and attenuation. But one or a few muscles are compromised in the beginning. The muscles of the hand are mostly the first to suffer; next those of the shoulder. Sometimes the disease starts in the muscles of the neck, but rarest in those of the face. With the progress of the lesion the muscles lose their energy and bulk, and become at last extinct, both physiologically and structurally. The atrophy of the ball of the thumb is most conspicuous; next, is the collapse of the inter-metacarpal spaces. The shoulder becomes flattened, and the spinous processes of the vertebral column abnormally prominent. In the affected muscles fibrillary quivering and oscillations are excited by exposing the skin to a breath or cold temperature. The muscles respond to Faradayism as

* Path. Anatomie, Vol. ii. page 228.

fasciculæ remain; and the excited muscular contractions are in proportion to the intensity of the induced current and the still remaining normal tissue. In exceptional cases the disease may limit itself to one or the other group of muscles; and mostly it proceeds from one province to the other, and then it constitutes a most formidable malady, with all or most of the symptoms which I have related in Cruveilhier's case. It is not often that the affected muscles become sore or painful, and equally rare is deformity observed in connection with this disease. Its course is spread over several years, and death is sometimes hastened by bronchial and pulmonary affection, from the fact that the patients have no muscular power to sustain expectoration.

Among those cases recorded, the male sex is more numerously represented. Some authors claim for their respective cases hereditary diathesis. As remote causes, violent muscular exertion and cold are assigned. From all statements, it seems patent that very little is known of the causation.

The treatment of progressive muscular atrophy is limited to recent and mild cases. Persistent and methodical Faradization has been found serviceable in arresting the progress of the disease, and in maintaining the normal structure. In advanced cases, none of the remedies hitherto tried have served the purpose. The treatment in these is an entirely open question, and a free ground for therapeutical experiment.

CHAPTER XII.

RACHITIS.—RICKETS.

Causation.—Pathology.—Symptoms and treatment of rachitis.

FORTUNATELY, rickets is one of the rarest maladies on the Western Continent. During a practice of fifteen years, I have not seen a case of aggravated rachitis. This fact speaks volumes in proof of the prosperous condition and the high hygienic order of the people of the United States. The few cases that present themselves are due to transmigration.

Rachitis is an acquired malady of infantile life, and but exceptionally of congenital origin. Its inception falls generally into the period of lactation and dentition. Pining, atrophic, and badly maintained infants are apt to engender rachitic disorder. Musty dwellings, defective in ventilation and sunlight, are its very hatching-places. Rickets is eminently a disease of pauperism. Among the humbler classes of England the disease is very prevalent, and for this reason it is known all over Europe by the term of "English disease." Healthy children, with good surroundings, are occasionally subject to this complaint, and in them the latter assumes a very acute character; such are, however, but exceptional occurrences.

Most authors claim that rickets is usually preceded by catarrhal affection of the alimentary canal, and often ushered in by diarrhœa infantum. With us, these troubles are quite common during the hot season, and even epidemic; but the imputed consequences upon the integrity of the skeleton are entirely wanting.

That continuous moisture of the domestic atmosphere acts as a morbific agent, has been conclusively demonstrated by experiments upon animals. Beyond this, nothing positive is known as to direct causation.

The hypothesis has been entertained, that lactic acid, preponderating in the blood, was the morbid solvent of the calcareous substance in the bone; and this opinion has been strengthened

by the fact that lactic acid is copiously found in the urine of rachitic patients. To this hypothesis are, however, opposed:

1st. That lactic acid is no constant component of rachitic urine.

2d. That the malady is not always preceded by conditions favorable to the generation of lactic acid.

3d. That the scarcity of earthy matter in rickety bones is but one, and seemingly the lesser pathological defect; and

4th. That the cell-proliferation in the third layer of the periosteum, the endosteum, and in the epiphysal cartilage, is not reached by the stated theory.

The same objections pertain to the views of Virchow, the premises of which likewise rest on disordered digestion.*

Most inquirers coincide in the opinion that rachitis is a species of *deranged nutrition closely allied to inflammation.* It must be the one or the other! Before I venture upon an opinion as to the proximate cause of rickets, I will first survey the anatomical condition of rachitic bones, as furnished and investigated by eminent pathologists (Rokitanski, Virchow, Kölliker, Mayer). For the pathogenesis, it would have been of incaculable importance to determine in what part or tissue of bone the disease sends forth its first manifestations. And in this particular the researches of the fore-named authors are unfortunately defective.

The pathological changes in rachitic bones refer to both texture and form.

In the subperiosteal layer, the *cambium* of some authors, there is a luxurious proliferation of cells observable, imbedded in a pinkish intercellular fluid. The firm attachment of the fibrous layer does not thereby suffer. From the former the formation of new bone is gradually effected, alternately in the shape of osseous palisades, standing rectangularly to the bone, and of horizontal layers. The two are intersected with so-called Haversian spaces, filled with a pinkish and apparently oily

* The chemical elements of bone in the blood are in a state of solution, probably through the presence of carbonic acid. In the act of deposition in the bone, their solvent is probably withdrawn by some, as yet unknown, catalytic process. The return of earthy matter to the circulation must necessarily be preceded by a solution of them. Whether this is effected by an acid, which becomes disengaged in rachitis, as Virchow presumes, or whether the catalytic process in the ossification of bone is simply reversed, must necessarily remain a matter of speculation.

substance. The calcareous matter is defective in quantity and rather of a porous character (probably from the proliferation of the blood-vessels).

The medullary cavity is absolutely enlarged at the expense of the old bone; so much so, as to vanquish it entirely in some instances.* The enlargement proceeds in both directions, and leads, in extreme cases, to a perforation of the epiphysal cartilage. This process is characterized by an enormous increase of cell-corpuscles of the medullary membrane, and by the copious secretion of a fluid and reddish marrow. Not rarely medullary recesses are formed, advancing toward and terminating in the new bone-layers.

Both the periosteum and endosteum exhibit great vascularity and hyperæmia.

Next, there is a considerable enlargement of the epiphysal ends of the cylindrical bones, owing to swelling of the epiphysal cartilage, which occasionally presents the extraordinary thickness of 5‴. In microscopical examination, the cartilaginous cells themselves are not only enlarged, but multiplied in number; and throughout the entire substance there is a pinkish pulp transfused, which deprives the cartilage of its elastic endowment, presses it out between the bone, and gives it a bluish tinge. At the ostoid layer, the organic elements of young bone continue to form; but defective, or entirely devoid of the calcareous complements.

During the progressive course of the rachitic process, the organic portion of the bone seems to be in excess, but the deposition of the earthy material does not keep pace. Hence the bones are bendable; the cartilages so much softened that they, as for instance the costal ones, may double upon themselves. But when the rachitic process recedes, and the calcification of the osseous stroma fairly commences, it scarcely ever acquires the structure of healthy bone, remaining osteo-porotic and unduly fragile, or turns into osteosclerosis.

How this elementary condition of the osseous structure reacts upon the size and form of the skeleton, may be readily conceived.

In reference to the former, it must be noticed, that the growth and development is more or less arrested. The patients remain

* Consumption rachitique (Guérin's).

undersized, and sometimes dwarfish. The extremities of the tubular bones exhibit bulbous enlargements, which age cannot completely obliterate. They, moreover, bend to the superincumbent weight of the body, and yield their normal shape to the action of the muscles. They not rarely suffer infractions, and close thereby the medullary cavity. By the eccentric formation of new bone, the old one loses its contours and assumes the shape of a regular cylinder.

The flat bones suffer rarification, cranio-tabes, and at a later period massive thickening. The ribs bend at their angle, flatten at their arches, and push the costal cartilages forward with the sternum. The deformity of the thorax arising from this source, is known by the term of chicken-breast (pectus carinatum). The spine yields to superincumbent weight, which occasions an arched posterior curvature. The pelvis becomes narrowed in the antero-posterior diameter, conjugata, and widened in the transverse, which gives to the brim of the true pelvis the shape of a heart in play-cards. The muscles in rachitic patients appear pale, anæmic, and slightly fatty. Owing to the consumption of the adipose tissue, the little patients become much reduced in weight and appearance, and exhibit the characteristic senile features.

Though it is to be regretted that we possess no positive knowledge as to the chronological order in which the pathological changes develop in rachitic bones, yet the researches are sufficiently explicit to venture upon an interpretation. Meyer suggests periostitis as the proximate cause of rickets. With this view, I cannot harmonize the observations I have made of this and kindred diseases of the skeleton. It seems to me that the periosteum of rachitic bones suffers much less than in ordinary osteomyelitis. In the latter, the periosteum is, aside from the abnormal cell-growth, thickened, partly detached, exposed to purulent maceration, and frequently perforated. Nevertheless, in this as well as in the rachitic disorder, the periosteum preserves its functional powers of creating new bone to such an extent as to furnish massive material in the place of the old structures, more or less completely vanquished. The formation of new bone in periostitis seems to me inseparable from granulation, and this does not exist in rachitis.

In comparing the respective pathological changes of the peri-

osteum with those of the endosteum, we can scarcely fail in recognizing that they supervene in the latter. In the medullary membrane we find all essential attributes of inflammation, to wit: increased vascularity, hyperæmia, morbid secretion, proliferation of the cell-corpuscles in the connective tissue, the destruction of normal tissue, occasionally to a vestige. This is obviously not a simple vitiation of nutrition, terminating in fatty degeneration of the bone, as Paget* has it, and in contradiction with Von Bibra, who found but six per cent. of fat in the ulna of a rachitic child. I am therefore rather disposed to accept Stromeyer's† pathological views, which are consistent with the histological changes. According to this distinguished writer, rachitis is identical with ostitis, of more or less all the bones of the skeleton. It may be worthless to take issue with Stromeyer on account of the term. For most writers have dispensed with "ostitis," because, in bone proper there is no substance that could possibly become subject to inflammation. Henceforth "osteomyelitis" is employed in place of ostitis, and a more general character has been accorded to the former. Already Cassaignac allows a more general occurrence of osteomyelitis, although his definition of this disease is much more contracted than is warrantable. Demmé admits, likewise, multilocular osteomyelitis. And Rockitanski‡ distinctly states that ostitis may befall in more or less rapid succession most and all bones of the skeleton.

There is no proof that rachitis invades all bones at one and the same time; on the contrary, and from the different opinions of authors on this point, it is reasonably to be inferred that the disease spreads gradually from one part of the skeleton to another, irrespective of situation, and may even be limited to one locality.

The fact that rachitis does not proceed to suppuration, with which some authors have identified osteomyelitis, is indeed no evidence to the contrary. Even Demmé admits that it may stop short of suppuration, and eventuate in resolution.

The supposition of osteomyelitis as the pathological base of rachitis, furnishes at once a clear understanding of problems

* Surgical Pathology. Page 99.

† Stromeyer, Handbuch der Chirurgie. B. ii.

‡ Pathological Anatomie. Bend 2, page 117.

which have greatly puzzled the profession; and it would seem to be indifferent whether the calcareous substance in the last instance disappears by a chemical (lactic acid) or by a vital process. That much seems to be clearly demonstrated, that the disease leads to *the removal of the earthy matters*, and *equally prohibits the formation and deposition of new substance.* Hence all attempts must prove nugatory to supply the patient with phosphates. They will only augment the discharge of calcareous salts in the urine.

The symptoms which accompany the rachitic process are in part comprised in the changes in form and consistence of the affected bones, partly by the chronic affections of the alimentary apparatus. With these are associated the signs of general debility and waste of substance. Moreover, there seems to be a general tenderness of the patient, who makes hardly any effort at locomotion, and who seems to be most comfortable when left alone and undisturbed in bed. Every attempt to raise the child sets it crying, which must be brought in connection with the tenderness of its body.*

The *prognosis of rachitis* generally is much more favorable than might be expected from a malady that is evidently of a constitutional character, and that has led to so extensive structural derangements of more or less of the entire osseous system. The restitution of general health and structural integrity may therefore be counted on, if the disease is not aggravated by serious complications, or advanced to malformations of the skeleton which necessarily impede the free actions of vital organs. Thus, for instance, if the skull is deformed or thickened by hyperostosis, the brain may be compressed and its function interfered with. Like impediments may arise from the distortions of the chest upon the heart and lungs, in themselves of vital import and consequence. But, however favorable the termination of rickets may be, the body will scarcely ever get free from the effects of temporarily arrested growth, and more or less manifest the effects of the malady upon single bones, more especially upon those of the spine and extremities.

* Bouvier, Trousseau, and recently Stromeyer, refer to imperfect respiration of rachitic patients, which, according to the last author, becomes manifest in the diminished action of the mus. serratus anticus major. If it exists, it has escaped my observation.

Complications with derangements of the digestive organs, catarrh, diarrhœa, etc., must necessarily exercise a most prejudicial influence upon the recovery of the like cases. Advantageous domestic conditions would seem to allow a more favorable prognosis in this than in any other disease.

TREATMENT OF RACHITIS.

The first solicitude of the attending surgeon should be, to remove his patient from a vitiated domestic atmosphere into purer and invigorating surroundings. Mountain or country air is calculated to benefit the patient more than anything else. The neighborhood of oceans and rivers should be obviated, as moisture in general. Where the means are not available, the patient should be carried or drawn in the open air in a little wagon, as often as circumstances will permit. Meanwhile the sick-room should be thoroughly cleansed, aired, and lighted, and permanently kept in as good hygienic condition as practicable. If warm baths, with a solution of raw sugar, a decoction of calamus and malt cannot be had, frequent ablutions should be resorted to, as a substitute to promote the action of the skin, which is so desirable.

The diet should be both light and generous. Plenty of new milk, fresh butter, new-laid eggs, strong broth, raw meat, particularly beef, and fat fish, especially eel, and light wheaten bread, constitute the best bill of fare for these patients. If the patient is still nursed by the mother, it will be well to pay due attention to her health. Women with child are unfit for nursing. If they suffer from habitual constipation of the bowels, their milk is sour, and thus diarrhœa of the infant is engendered. She has to take aperients as often as is needed. Mothers of sedentary habits should be induced to take daily open-air exercise, which promotes health and renders the milk more salubrious. If the mother has not milk enough to keep her child sufficiently supplied, a wet-nurse is better substituted. For the woman's milk is, without comparison, the best diet for rachitic children.

Whilst residing in London, England, I was consulted with reference to a child about four years old. It presented the most

aggravated form of rachitis, to which mesenterial atrophy was superadded. The little patient was reduced to a deformed skeleton, and barely covered with dryish skin. The stomach rejected food; besides, diarrhœa supervened, and the alvine evacuation evinced traces of pus. The discharges were badly mixed—very liquid and extremely foul. The teeth were rotten and sharp. Medicinal treatment had been fairly tried, and had utterly failed.

Though the child was rather superannuated for the purpose, I nevertheless insisted that he should be put to the breast of a good wet-nurse. After repeated failures, we succeeded in getting the child to comply. The effects were most astonishing, and the child so rapidly improved in weight and appearance, that after four months we could safely return to more substantial food. Thus by proper diet a disease was subdued which seemed to have passed all hope of recovery. Wine as an article of diet has been strongly recommended, more especially the Hungarian wines; and among them Tokai, which copiously contains phosphates. Next to them, Malaga wine has been in favor. Most probably they are beneficial through their saccharine and alcoholic components, partly as an aliment, partly as a stimulant. Specific virtues they have none.

The cool or bittern baths made of the mother liquor are serviceable in rachitis, particularly when the patient is not far advanced in the atrophic stage. In the latter, cod-liver oil is very much esteemed, and acts probably as an available, cheap, and digestible aliment.

The introduction of phosphate and carbonate of lime is worthless. The preparations of iron have proven beneficial and serviceable in rickets.

The next indication is the prevention and relief of osseous distortions.

I know no other means to respond to the former, than the horizontal position of the patient upon a well-made horse-hair mattress. Upon this the patient has to lie and to be carried about until the bones have recovered their firmness and elasticity. The supine posture alternately with the prone, may be advisable to counteract the tendency to the distortion of the thorax. If the distortions have already taken place, the treatment must necessarily vary, whether the skeleton is still soft and yielding,

or already hardened by the infusion of calcareous salts. In the former condition, we use such manipulations and means as are calculated to restore the form. In the tubular bones this is not so difficult after all. Either with or without the assistance of anæsthetics, we take hold of the deformed bone and draw it simply out, or bend it over a soft hypomochlion, or retwist it. The softer the bone, the easier this can be accomplished. In more solidified bones, repeated manipulations of this kind may be needed. It would not be advisable to apply splints for this purpose. For if they are tightly adjusted, they may do more harm than good, by compressing the bony cylinder; and if they are lightly used, they can serve no purpose at all. The same manipulation may be effectually employed in pectus carinatum. The hands of the surgeon should be placed upon the front and back of the chest, and the same gently but steadily compressed for a few minutes at a time.

Rachitic kyphosis may be remedied by the recumbent position upon an even mattress, or may be bent over a convex cushion.

All these efforts will prove nugatory in bones already hardened and inflexibly shaped; they then offer a wide field for mechanical genius.

For anybody at all capable of appreciating the mechanical derangement of the skeleton, it will not be so very difficult to find the appropriate mechanical remedies, either among those I have submitted to you, or by combining them. You will readily conceive that the dorsal screw I have mentioned in connection with the treatment of talipes, will find a useful employment in the straightening of tubular bones. A metallic splint for the cavity of the distorted member, to which the double screw is fastened to act upon the convexity of the bone, would constitute as cheap and as effective a mechanical contrivance as one could wish. Or if you prefer braces for the extremities, you may attach movable pads, and thus render them effective. My hip instrument commends itself to your consideration in the mechanical treatment of the rachitic distortion of the lower extremities, for self-evident reasons. But if the bones have become so completely hardened as to be beyond mechanical influence, then other and operative means may be called for.

Meyer has, some fifteen years ago, introduced osteotomy, with a view to correct this form of cylindrical bones, distorted by rachitis, and has since then performed the operation upon a considerable number of cases with the most satisfactory results. Similar good returns have been made in America, and in all I know, but one case terminated fatally, that of Prof. Linhardt. Few operations have been ushered in under more auspicious circumstances than osteotomy. The technicalities are very simple. An incision is made sufficiently large to give free access to the bone. The latter is thereupon either incised by a saw and the rest broken through, or a piece is cut out from the continuity. The form of that piece depends, of course, on the deformity itself. Sometimes it is to be a wedge, at another a crescent, and so forth. The ends are to be properly adjusted, the wound closed by sutures, and the case treated as compound fracture.

B. Langenbeck has modified the procedure in this way, that he makes but an incision of one inch in length, penetrates the bone by a drill, and completing the division by a narrow saw, by cutting outward to the circumference of the bone.

Langenbeck's "*subcutaneous osteotomy*" offers the great advantage of not disturbing the relations of the periosteum to the bone. But, on the other hand, it must prove inefficient where more than linear division of the bone is required to reëstablish its normal form. Moreover, it would seem that the operative field is rather too circumscribed for the purposes of this operation; and, in fine, the dangers of leaving sawdust behind, and in missing first intention, is certainly not exaggerated.

CHAPTER XIII.

CAUSATION OF JOINT-DISEASES.

The strumous theory untenable.—Cruveilhier's experiments.—No pauperism, but joint-diseases prevalent in the United States.—Frequency of joint-diseases in childhood, among boys, in cities and more northern latitudes.—Their rarity among adults, in the female sex, and in the South.—The antiscrofulous treatment utterly worthless.—Local and mechanical treatment effective.—Traumatic injuries the chief cause of infantile joint diseases.

GENTLEMEN:—In compliance with your gratifying invitation,* I propose to discuss some important points pertaining to articular diseases. This is possibly the only subject with which I may hope to engage so distinguished an audience.

The last ten years have been fruitful of material advancement both in the pathology and in the treatment of this class of affections, and their cultivation is still vigorously and diligently pursued. Notwithstanding all the achievements in that direction, the subject still remains in a state of transition, through the tenacity with which one portion of the profession adheres to the venerable teachings of the past, and the enthusiasm with which another portion declares itself in behalf of modern ideas. The time has certainly come when an understanding should be effected by means of unbiased critical analysis and clinical experience. With this object I enter upon the present discourse. If, through inability, I should fail of realizing my design, I may at least hope to place the subject-matter in such attractive relief as to insure your permanent interest and active participation in the settlement of the pending questions.

* These lectures have been delivered at the McGill University, Montreal, at the invitation of its distinguished medical faculty, and subsequently published in the Canada Medical Journal, Vols. III. and IV., 1867. I take this opportunity of expressing my grateful acknowledgment for the many marks of esteem, courtesy, and unbounded hospitality received at the hands of the leading professional men of that rising and prosperous city; and more especially to the venerable Dean of the Faculty, to whom I am personally indebted for many favors and acts of confidence.

On this point, there is a decided clashing of views. By far the larger number of practitioners, the leading members of the profession among them, are of the opinion that most cases of this class are the result of constitutional disorder, of which the articular affection is but the localized symptom. To this theory the most prominent authors on surgery are committed, and it is promulgated from the professorial rostrum and at the bedside. Time and usage have even rendered it popular with the laity. A few modern inquirers, comparatively insignificant in name and position, not only take exception to this theory of causation, but assert that articular maladies are excited exclusively by local causes, and that the constitution bears no part in the causation. They further maintain that where the constitution suffers, it suffers from the ulterior effects of the local disease.

As long as etiological views on this subject so widely diverge, there can be no uniformity of treatment; nor can a compromise be effected between views so diametrically opposite. The only way of deciding between two, of which only one can be right, is to analyze the grounds upon which they are respectively placed. I hope the venture on my part in doing so will not be deemed presumptuous, for the conflict of etiology exists, and its settlement is certainly desirable. Too much has been already conceded by the old school to warrant a proud denial; and no party can feel aggrieved when appeal is made to the decision of "stubborn facts."

Scrofulosis, rheumatism, gout, syphilis, scarlatina, pyæmia, and other diseases, have been enumerated as constitutional causes of joint affections. To strumous disease, however, has been assigned the first rank, inasmuch as it has been linked with the numerous and diversified cases that happen during childhood. From my own experience, I have to infer that not less than ninety per cent. of all articular affections occur before puberty. Inasmuch as scrofulosis is not limited to childhood, and is supposed to extend beyond puberty, a few more per cent. may be added to the original proportion, making a percentage of about ninety-five. Thus the theory of constitutional causation narrows itself down to the theory of strumous causation, and with this we shall have essentially to deal.

In entering upon our investigation, gentlemen, we meet with

the singular fact, that notwithstanding the general acceptance of, and acquiescence in, the stated theory, nobody seems to know accurately what strumous disease really is. There are certainly no two writers that fully agree in its definition, nor does scrofulosis rest upon any firm pathological base. Even its clinical character is rendered so indefinite that implicit faith and a goodly stretch of imagination are required to realize its attributes. This is the status of modern literature on the subject; and in extending our researches over a more remote literary period, we are not less surprised to find that the scrofulosis of the present is a materially different malady from that of the past. The pathological school of the humoralists has identified this disease with a distinct morbid principle, a *materia peccans*, contaminating nutrition throughout, and stamping all other incidental lesions with its peculiar unalterable character. The followers of that school very consistently resorted to starvation, vegetarianism, and to mercurial and antimonial preparations, for the purpose of freeing the system of that *deus ex machina*. With the physiological school the agent of strumous disease was mollified to a mere imperfect formation of proteine compounds. They very wisely adopted opposite treatment with a view to regulate the chemical transactions of the body, and to correct the catalytic combinations of the proteine. Both schools accepted perverted hygiene and diet as the remote causes of strumous disease, and consistently believed that it was a disease of pauperism. Again, both schools insisted upon strumous diathesis and a hereditary transmission. These last views are fully compatible with the humoralist principle of pathology, but indefensible from the stand-point of the physiological school. Certain appearances of patients may indicate perverted nutrition; and a morbid principle thereby engendered may, like syphilis, be transmitted to generations. But a diathesis for the formation of low-graded proteine combinations is a senseless construction, and the hereditary transmission of such compounds is equally without meaning and inconsistent with the chemical tenacity and restitutive powers of individual life.

Science in its advancement has already made some substantial inroads upon the strumous domain, and narrowed its borders at some vulnerable points. Porrigo capitis and sycosis menti,

formerly claimed as specific strumous forms, have now been proven to be caused by insignificant vegetable parasites. The very prototype of scrofulosis—viz., keratitis scrofulosa—has been reclaimed by modern ophthalmologists as an independent and exclusively local lesion, readily yielding to local appliances. And new incursions are threatened from other sides. Help was evidently needed to uphold the loose cohesion of the scrofulous architecture, and to save it from pathological downfall. It was but too readily found in tuberculosis. By incorporating the latter with strumous disease, some anatomical tangibility was secured. Gradually the new pathological element has prevailed so completely, that but the name of the old scrofulous doctrine remains. In talking about strumous infiltration, *tubercular infiltration* is meant; and in fact in its former and present application, the tubercular element has completely superseded the strumous one. The transition from one to the other has been effected so clandestinely as to be noticed but by very few. The alliance between scrofulosis and tuberculosis proves, if anything, that neither had ever acquired a self-sustaining existence. Both diseases are clinically and anatomically different in character. One is said to prevail among children, the other among adults; and only exceptionally is this rule reversed. The organ which one chooses is but rarely sought by the other. Their very presumed causes differ most essentially—one said to be the result of poverty and sanitary defects, the other having no respect for gradations of wealth and station. They differ even in geographical distribution. Notwithstanding all these differences, they are, by tacit understanding and acquiescence, identified as the same disease. It would be unjust, however, to say that this transition has been effected totally without opposition. Of late the pathological character of tuberculosis has been subjected to various and close investigations. Its identity with pus has been asserted by Cruveilhier. The results of his experiments upon rabbits demonstrate at least this much, that pus is susceptible of undergoing the very same metamorphosis as tubercle, from the semi-fluid condition to perfect innocuous calcification.* The

* The recent very meritorious experiments of Villemain, leave the question involved still undecided, since the subcutaneous inoculation of pus, inflammatory lymph, and organic detritus, furnish almost the same pathological results as that of tubercular matter.

strongest advocates of genuine tuberculosis have been forced to admit that there are often pus-corpuscles, where the external appearance of the object denotes tubercular substance. Few authors have had better opportunities of studying the pathological anatomy of bone and joint diseases than Gurlt, of Berlin; his investigations extending even over the veterinary field. If I correctly interpret his statement, he has met with no tubercle in joints and bones at all. What other authors had pronounced to be tubercular infiltrations and caverns, he recognized as purulent infiltration, the result of osteomyelitis; and as bone abscess, the sequence of circumscribed ostitis. And Virchow, one of the most esteemed pathologists of our time, considers himself justified in stating that tubercle is fully compatible with the acknowledged changes of inflammatory products. Again, gentlemen, is there any peculiarity about tuberculosis that could be established and accepted?

You are aware that the so-called tubercular cell has been asserted, but the microscope has failed to prove its reality. If the microscope cannot substantiate any peculiarity, how much less can the naked eye! For there is certainly no difference in appearance between tubercular matter and cheesy pus; and the suspicion of identity must necessarily accrue from such conformity. At any rate, our knowledge on the subject is not final and exhaustive; and we may justly look for further disclosures rather detrimental to, than confirmatory of, the genuine character of tuberculosis.

But, to return to the starting-point of our discourse, I shall find ample occasion to show that the strumous theory, in its practical application to articular diseases, is worthless, and rather injurious than otherwise; as it certainly has long diverted us from a course of investigation that could alone lead to practical results.

Consistently with the received opinions, the lower classes of society must come in for their full share of joint affections simply because they are supposed to contend with poverty and hygienic neglect. If this assertion had any show of correctness, it would imply that where we find joint diseases, there we ought to expect poverty and hygienic neglect. But clinical experience in a great measure contradicts the assertion. These affections happen in all

classes of society. They do not pass the mansions of the rich, nor are the agricultural districts exempt from their visitations. Yet, withal, it must be allowed that there is, in the abject domestic condition of the industrial classes of Europe, a plausible reason for assuming that they are more subject to chronic derangements of nutrition than the wealthy portion of society. Nor can the action of such nutritive derangements upon local diseases be altogether denied. At any rate, our pathological associations tend to confirm this supposition; though it may be clinically difficult to qualify the exact measure of those constitutional colorings of local lesions. Those who have had the opportunity of personally investigating the actual social status of the European proletariate and pauperism, agree that it is deplorable in the extreme. They occupy in cities the worst of dwellings, in the lowest of quarters; their rooms are overcrowded, their articles of food are of inferior quality; multitudes subsist upon offal; their opportunities for cleanliness are limited, and little resorted to; their very existence is a contest for the necessaries of life. Many of the working-classes and paupers domiciliate in places inaccessible to air and sunlight, in damp and musty basements where but fungi thrive.* The combined effects of these unfavorable surroundings upon mind and body are so appalling to the humanitarian as to be remembered with painful sympathy. They give rise to the most aggravated forms of so-called strumous disease, with which the public hospitals and dispensaries are crowded. It is but natural to associate so conspicuous a morbific agency with a class of diseases seemingly devoid of other causes, and reacting heavily upon the nutritive standard of the patient.

In contemplating the financial condition of the same classes in the United States, we have no difficulty in finding an entirely reversed status. Here the demand for labor far exceeds the supply, and its compensation has therefore for years past been very remunerative, so as to furnish ample income to every individual who aspires to an honest living by handiwork. The "Trades Associations" have, under these circumstances, readily succeeded in controlling employers, and in imposing upon them

* According to the latest statistics, ten per cent. of the entire population of Berlin live in cellars and basements.

their own terms for labor. However premature the eight-hour labor movement may have been, this much is to be inferred from it, that the working classes are almost the sole arbiters of their own affairs, much to the oppression of the other factor of industry. So great has been the demand for hands, as to necessitate the employment of thousands of women and children. Nothing serves as better evidence of the financial thrift of labor than the acknowledged prosperous condition of the Savings Banks. Hence the domestic state of the working classes is infinitely superior to and beyond all comparison with that of their transatlantic order. In fact, the humblest laborer here finds himself in the possession of enjoyments which would be estimated as luxuries in Europe. However imperfect the tenement-houses may be when compared with the dwellings of the wealthier classes, still they are comparatively spacious, well-lighted, and accessible to current ventilation. The food of the working classes is bounteous and wholesome, and there are very few families but have animal food at least once a day. Copious water supply to tenements insures all facilities for cleanliness; and public baths are accessible to all at a moderate rate. A glance at the attire of our industrial classes on a Sunday, gives us volumes of proof of the comparatively easy circumstances by which they are surrounded. What might have been anticipated *à priori* from their superior conditions is confirmed by practical observation—viz., that our industrial classes exhibit a better general health, a robust appearance, and none of those excessive forms of nutritive derangement which are comprised under the collective term of strumous disease. The contrast existing, for instance, between the populations of New York and Vienna can scarcely be overdrawn. In the Austrian metropolis, almost every person one meets looks sallow, anæmic, attenuated, physically impoverished, afflicted with swellings, ulcerations, and cicatrices of the cervical glands, of which in our midst there is hardly a trace.

The comparison to which I have drawn your attention, gentlemen, is between Europe and the United States, with which I am best acquainted. Whether my remarks apply equally to your prosperous provinces, you can decide best.

Notwithstanding the superior advantages, facilities, and prosperity of our industrial classes, and notwithstanding the fact that

scrofulosis in general has found amongst them but a limited ground of development, we meet, at least in the Northern States, with numerous cases of articular diseases for which constitutional causes cannot be assigned. What, therefore, is plausible for Europe is inadmissible with us; and this very circumstance was the first shock which unsettled my belief in the theory of strumous causation. In defence of the old theory, it may be urged that tuberculosis prevails in the United States, and satisfactorily accounts for the occurrence of joint diseases. Such an argument cannot be accepted as tenable, though the facts appropriated as premises may be conceded. For it so happens that tuberculosis is met with North and South, and apparently much more frequently in the latter. Among the negroes of the South, for instance, glandular affections are quite common and easily accounted for by their principal vegetable diet and hygienic indifference. If, therefore, the proposition be correct, it will follow that joint diseases are more frequent in the South, and especially amongst negroes, than in the Northern section of the country. This is, however, not the case: on the contrary, the further one proceeds South the less he meets with articular diseases; and according to the statements of competent surgeons of that region they become perfect rarities near the Bay of Mobile, the Gulf of Mexico, and the West Indies. But, irrespective of this geographical limitation of joint diseases, we have a right to demand ocular demonstration of the *tubercular deposit* alleged to be the *corpus delicti.* There are very few physicians who pretend to have seen tubercle in the affected structures. Thus, for instance, Professor Gross, who is one of the warmest advocates of the theory of tubercular causation, owns that he has never met with tubercular deposits in joints. He finds sufficient evidence for his opinion in the fact that a patient dies from tuberculosis after having suffered from joint disease. This sort of logic must pass for what it is worth. It has never converted me. For, by the same reasoning, we might come to the conclusion that a furunculus, a paronychia, or a fracture, happening to a consumptive patient, are of a coördinate character with tuberculosis of the lungs.

Gentlemen, I have submitted to your mature consideration my doubts as to the correctness of the time-honored and prevailing opinion of strumous and tubercular causation. All I can desire

of you is to look upon my arguments as suggestive. For my part, I have bid adieu forever to the old theory, as an unsafe guide.

Now if the facts adduced are true, and my reasoning consistent with them, and if I have made out a clear case against the strumous or tubercular causation of joint diseases, it follows that there must be causes other than those heretofore assigned. To find them out and to prove them as such, will be "the next business in order."

I have already observed that about ninety per cent. of all articular affections fall upon the period of infantile development. The proportion is, however, very different in different ages of childhood. An articular disease is certainly a rarity among infants,—we seldom see it before the expiration of the third year. From that age upward to the fifth year, these affections become more numerous, and attain perhaps their highest numerical proportion at the sixth. Then they commence to diminish gradually, and at about the tenth year they are reduced to but few recent cases. Toward puberty these are probably as rare as during the infantile period. I need not state that these facts are based upon a careful statistical record of my own, and are borne out by the experience of well-employed surgeons. I think it is apparent that the strumous theory does not offer a satisfactory explanation of these facts, for the prevalence of the disease is not supposed to be restricted to any particular period of childhood. We must therefore look for a more consistent explanation. The period of infancy is that of special parental protection. The child is mostly under direct charge of the mother or nurse; independent locomotion not having then commenced. The second and third year of infantile life enjoy less or more the same protection against accidents and injuries. With the fourth year a new epoch commences. The child is curious and inquisitive; it wishes to examine and to touch everything; it climbs upon chairs and tables; it trusts to its own guidance, and escapes from the protecting eye of its mother; and it is thus exposed to all sorts of falls and mishaps. With advancing age and knowledge of its surroundings, the child becomes more appreciative of danger, and more careful and timorous in its ventures. At a later period, when judgment and prudence assume their sway, acci-

dents, and particularly falls, become of rarer occurrence. Reasoning from these facts, I cannot but conclude to regard traumatic injuries as the sufficient cause of joint diseases during childhood.

With this supposition coincides a cordon of additional facts equally demonstrative, viz.:

1. Joint diseases are not limited to any particular class of the population, nor to cities; on the contrary, they occur amongst all classes of society, and in agricultural districts as well as in the densely populated foci of industry.

2. Joint diseases conform to certain latitudes.

3. Certain joints are more often affected than others.

4. Boys are more subject than girls, and sanguine and impulsive children more than phlegmatic and indolent.

5. We rarely fail to trace the attack to traumatic antecedents.

6. Constitutional treatment *per se* has proved of no avail in articular affections.

7. In fine, positive results follow the exclusive local treatment of these lesions.

At 2 I do not mean to imply that climate exercises any direct or specific influence upon the numerical distribution of articular diseases, notwithstanding the undeniable facts previously adduced. But inasmuch as the temperament, usages, diet, domestic habitations, tastes, employments, etc., of the inhabitants differ according to latitude, we may be justified in speaking thus of the generative causes of disease. In comparing, therefore, the Northern and Southern States of the American Union, we notice differences in this respect most material in their ulterior pathological consequences. The temperament of the purely Southern people is less sanguine and excitable than that of their Northern compatriots. The calmness of the Southern man is the result of his climatic constitution, and is in every respect natural, whereas the imperturbability of the New Englander is the effect of incessant social and religious discipline. The diet in one section is greatly farinaceous, in the other more nitrogenous. The habitations of the one are spacious but low, whereas the other dwells in four-story buildings. There the streets and the environs of dwellings are left as nature provides; here they are paved and improved in various ways with hard

surfaces. Ease has pervaded society in the South, whereas ours has been marked by constant bustle, expansion, restless and ambitious strife, and collision of interests. Our employments are greatly those of a commercial and manufacturing people, theirs are those of an agricultural community. In other words, our pursuits engender toil, emulation, and egotism; while their condition is simple, calm, and primitive. The same contrast exists less or more between the inhabitants of cities and agricultural districts. What bearing, you may wonder, have these differences upon the statistics of joint affections? Simply this, that a Northern child is more impulsive, ambitious, and quarrelsome, because he is confined, restricted in space, imposed upon, and brought into collision with other children. His animal diet renders him stronger and more irritable. Hence his liability to casualties. Again, a fall from a high staircase, or from a horse, wagon, fence, etc., upon a hard side-walk, pavement, or ice, occasions more serious effects than the same fall upon soft ground.

At 3 it is to be noted, that among all joint diseases those of the knee are most numerous; next in number come those of the hip-joint; next those of the bones and joints of the spine; then those of the elbow; then those of the tibio-tarsal articulation, etc. These well-known and acknowledged facts are not accidental, and the old theory fails to account for them.

It has always been alleged that strumous disease has particular affinity for the spongy and reticular structure of bones. If this be so, the tarsal, carpal, and vertebral bones should engender the disease more readily than any other portion of the skeleton.

Yet, as we have seen, the numerical preponderance happens at the knee and hip articulations; both these joints being more than any other exposed to injury by falls, blows, and other accidents.

The proposition under heading 4, needs no special comment. The fact that boys are more subject than girls to articular affections must be accounted for by their greater exposure to injuries. It is incompatible with the theory of strumous causation, because girls are more exposed than boys to the causes of that disease. At proposition 5 it is worthy of recollection, that at certain periods of childhood accidents are of very common occurrence, though they are generally disregarded as causes of

disease, unless they immediately eventuate in great pains, contusions, wounds, or fractures. The proof of connection is sometimes difficult, because weeks and months may elapse before the pathological effects clearly manifest themselves. In rare cases one follows the other so closely that the mutual relation is patent and unmistakable. That apparently slight injuries may suffice to lead to grave consequences, I have had frequent opportunities of observing. Allow me to relate but two instances in exemplification.

A little girl fell backward flat upon the sidewalk. She immediately experienced violent pain at a certain portion of the spine, and had to be carried home. I saw her soon after the fall. One of the spinous processes (the fifth dorsal) not only projected perceptibly, but was painful to the touch. The advice to keep the patient in the recumbent posture for at least three months was followed but for a short time, and the child was permitted to resume locomotion. At the end of six weeks, during which time the dorsal protrusion had noticeably increased, I was again invited to see the case. The little girl was then suffering from intense pleuritis of the left side, which eventuated within three days in copious exudation into the pleural cavity, with dislodgment of the heart. Death soon ensued.

The view I held and expressed was that the recent disease was connected with the fracture of the spine; that most probably an abscess had formed at the injured point in the column, and had discharged its contents into the pleural sac. The father, in order to relieve his mind from the indirect imputation of neglect, repressed his aversion to an autopsy. I need not assure you, gentlemen, that my diagnosis was in every particular verified. There was, indeed, a fracture of the fifth dorsal vertebra, though of very limited extent, a mere chipping off of a wedge-shaped fragment still connected with the next lower intervertebral fibro-cartilage. There was next, an abscess in front of the fracture and beneath the periosteum, with, as it were, two compartments, one on either side of the spine, communicating through the fracture. The left compartment, the larger of the two, had effected a perforation into the left pleural cavity. Besides this, disintegrations of bone, cartilage, and adjacent structures in general occupied the affected locality.

The other patient was a middle-aged man, a music-teacher, of German extraction. When under the temporary influence of liquor, he fell from an elevation of about five feet, and struck violently the internal circumference of his right knee-joint. The intense pain that set in forthwith soon sobered him, and impressed him strongly with the apprehension of grave injury to the articulation. A physician was immediately called, but failed to discover any injury. I saw the patient the third day after the accident. There were no superficial traces left by the fall. The articulation was hot, swelled, flexed, and extremely tender to the touch. From time to time, spastic oscillations appeared, and terrified the patient, who was pale and dejected from want of food and rest. I placed him under chloroform, extended the extremity, and secured the position by appropriate appliances. The trouble yielded without any further treatment; and, for aught I know, the patient recovered from an attack that might have permanently affected the articulation.

The interval of time between cause and effect, is, after all, more apparent than real. Many cases, especially those of affections of the spine, commence in so insidious a manner, and the initiatory symptoms are so general and indefinite, as to be excusably misinterpreted, not only by the parents, but even by the professional attendant. Among other cases of the kind, I remember one in particular, which had puzzled the physicians for a number of months, until a correct diagnosis was obtained.

The patient is a little boy of fine organization, of a most impressible and active nervous system. His agility and daring even to this day are extraordinary, notwithstanding the conspicuous posterior curvature which has gradually become established. He may have been five years old, or thereabouts, when he sustained a fall from a fence six feet high, causing at the time considerable alarm to him and his parents. But no perceptible disturbance of his health immediately following, all fears were dismissed and forgotten. A few weeks after the occurrence, the patient exhibited signs of general ailment, decrease of appetite, pallor, weakness, disturbed rest, irritable temper, and indisposition to join in the frolics of his play-fellows. Occasionally the pulse became accelerated, with contemporaneous thirst and increase of temperature. He complained of a transient pain in

the stomach. His alvine evacuations were sluggish, badly mixed, dry, of light color, and offensive odor. The abdomen was often distended with gas. The urine was pale, and deposited a whitish sediment. These symptoms prevailed for months without material change. The diagnosis of an "affection of the liver" was not without plausibility, inasmuch as that organ had become enlarged in all its diameters. At the end of the eighth month, frequent and painful hiccough was observed, and tenderness of the back became manifest on motion of the spine. In fine, his gait became awkward, and the movements of his body restrained and stiff. He craved for rest and support, which he obtained by placing his elbows on suitable objects, and his head upon the palms of his hands Ten months after the accident, my services were called into requisition. At this juncture it was easy enough to recognize the nature of the complaint. The marked prominence of several spinous processes at the thoracico-lumbar region of the spine rendered the diagnosis both transparent and conclusive. To the experienced practitioner, it may seem surprising that the diagnosis was not sooner accomplished, and the disease of the spine arrested by appropriate means. The entire train of symptoms pointed to a local lesion, of progressive tendency; and a searching examination could scarcely have failed to reveal the locality of the affection. Nevertheless, when we recollect the difficulties in the premises, the aversion of children to manual examination, the disinclination of parents to see their offspring thoroughly handled by the surgeon, and last, but not least, the limited field of general practitioners for fully observing and becoming conversant with these insidious cases, we will be sparing in our censure, even if it should be warranted. It cannot be denied that in the case submitted there was an uninterrupted connection between the accident and the subsequent disease. I have made the same observation in many cases that have come under my charge, and have no doubt that other observers have the same experience. Nevertheless, I am far from denying that joint diseases may arise from constitutional disorder likewise. But, according to my clinical researches, their number is proportionately insignificant. In cases of this character, we find originally more than one joint affected, though the disease may eventually fix itself upon one articulation. This

appertains more particularly to rheumatism, gout, and especially to pyæmia. When, on the other hand, but one joint suffers from the beginning to the end, and the constitutional symptoms supervening are in conformity with the inevitable reaction of the local process upon the general system, then it is rational to infer that the local affection is of strictly local causation.

Every candid practitioner will agree with the aphorism enunciated under 6. It is certainly a simple fact, that the anti-scrofulous treatment of joint diseases has disappointed both him and his patients. My own clinical training coincides with that period in which the old etiological views held unbounded sway. They consequently regulated my action at the bedside. I followed with full confidence and scrupulous exactitude the doctrines of my distinguished preceptors, Rust and Von Graefe. I coveted cases of this class, which seemed to be tacitly slighted by the more experienced members of the profession. But all my efforts were in vain. I accomplished no material change that could have been claimed as the result of devoted services. My cases took the usual course to complete obliteration of the respective joints—malposition of the affected extremities, suppuration, caries, exhaustion, and death. Nay, more, I had the mortification to perceive that I could but rarely control the intense pain usually attendant upon such cases. Similar admissions have been made by other experienced practitioners; and I am led to believe that the negative results of anti-scrofulous treatment of joint diseases are now generally conceded by that portion of the profession whose opinion has any value.

In the seventh aphorism I broadly assert without fear of contradiction that in the treatment of joint diseases, local appliances scarcely ever fail of modifying or subduing the morbid process. For the last ten years I have held these views, and practically tested them at the bedside; and I can candidly and most emphatically assure you that the results thus attained have been most satisfactory in every particular. In but few cases have I ever had any need for constitutional remedies. Most of them yielded readily to local means; and with the local improvement the prevailing constitutional disturbances subsided. When thus rest and appetite were insured, the patients increased in *weight*, and rapidly improved in appearance and feeling. I need hardly state

that my therapeutic views on this point were slighted for a number of years by those men to whom the profession look up for precept and example. But when Dr. Davis' portative extension apparatus became generally known, the professional mind underwent a material change, and then turned its attention to the subject. A few years ago the New York Academy of Medicine discussed the subject of hip disease at successive meetings. Most of those who participated in the discussion admitted in emphatic terms the therapeutic efficacy of that instrument, retaining at the same time the old tubercular theory of causation. Nobody seemed to notice the contradiction between theory and practice, and it was then and there that my views gained the ascendency. I simply stated on that occasion that but one could be right. "If hip disease were the consequence of strumous invasion, a portative extension of a few pounds could have no effect whatever in relieving or curing that complaint; and if it actually had the effect alleged, it would be the most undeniable proof against the constitutional character of the disease." The attempt to refute my logic was as feeble as it was unsuccessful, and from that date it may be said that the new theory was admitted to scientific citizenship. I shall not on this occasion enter more extensively upon the subject, inasmuch as I have to recur to it when speaking on the treatment of articular diseases.

CHAPTER XIV.

ANATOMICAL CHARACTER OF JOINT DISEASES.

Chondritis, if at all, of rare occurrence.—Structure of synovial lining.—Its susceptibility to morbid action.—Richet's experiments.—Periosteum.—Its physiological and pathological relation to infantile joints.—Epiphyses, their peculiar maintenance and exposure to traumatic injuries.

GENTLEMEN:—All the anatomical components of a joint may separately and collectively become diseased. Their morbid susceptibility varies, however, in a material degree. The articular cartilage occupies obviously the lowest point in the scale. In conformity with its purely physical office, it is elastic, only indifferently organized, and devoid of nerves and vessels. Its nutrition is therefore of a low order, accomplished chiefly by transudation and imbibition. Reasoning from these premises, it might *à priori* be assumed that this structure possesses but a trifling susceptibility to independent morbid action. This supposition receives additional strength from experiments upon animals by Redfern, O. Weber, and others, who found that neither physical violence nor chemical irritants have much lasting effect upon articular cartilage. The intervertebral fibro-cartilages are of higher organization, and are therefore endowed with a more decided susceptibility to morbid changes than those of joints. I have made clinical observations to this effect, and I have recorded one case of inflammatory disintegration of so striking a character, that no reasonable doubt could be raised against it. In advanced diseases of joints and of the spine it is impossible to determine whether the cartilage or some other structure has been first affected. The destruction is commonly so general as to leave no room for speculation. I am inclined to believe that the cartilage suffers but rarely from primary lesion, but that it often participates in the affection of the subjacent bone, and is subject to disintegration from purulent maceration.

That the cartilage displays but a passive character in the so-called *arthritis deformans progressiva* is now well understood.

The synovial lining is a sort of intermediate structure. It does not conform to serous membranes, with which it has heretofore been classed. Its greater thickness, albuminous secretion, and layered epithelium, bring it nearer to the anatomical structures of mucous membranes, from which it differs by the absence of mucous follicles. The Haversian glands are no glands at all, but synovial insaculations filled with fat. Gosselin's fimbriæ have thus far not met with general acceptance, nor have their functions been fully ascertained.

According to Richet, the healthy synovial membrane is very vulnerable. Injections of irritating fluids into the joints of animals are promptly followed by great vascularity, hyperæmia, pinkish and purple discoloration, and opacity of the synovial lining, with serous infiltration of the adjacent connective tissue. The vessels frequently cluster around the articular cartilage, and by anastomosis form as it were a continuous wreath from which returning twigs branch over the margin. Occasionally the synovial membrane becomes so œdematous and pouched as to circumvallate the cartilage as chemosis does the cornea. By degrees the entire surface of the joint becomes roughened and granulated. The epithelium luxuriates and is converted into pus-corpuscles which are successively thrown off, and the articular cavity is filled with purulent fluid (pyarthrosis); similar pathological changes may often be observed to follow penetrating wounds, with this difference, however, that in the beginning the synovial fluid forms a material constituent item of the discharge, and reappears occasionally when the process is subsiding. From these experiments it would seem that the synovial lining, notwithstanding its destitution of nerves and vessels, is highly susceptible to morbid action of the peracute type. But clinical experience has collected many facts to the contrary. Thus, for instance, some penetrating wounds close by first intention without inconvenience to the injured joint, although blood may have been left behind, and air may have entered. Many a time have I performed articular puncture by trochar and knife, without a single bad effect, having, of course, as much as possible prevented the entrance of air.

In hydrarthrosis, Nelaton has freely resorted to injection of iodine, and others have followed his example. According to their statements, only a moderate reaction usually ensues. Free incisions into affected joints have been made, checking the disease, and saving extremities. Amputations in contiguity leave always a portion of the joint, and some surgeons prefer these operations on account of better statistical returns. These facts constitute a formidable offset to the rule based upon Richet's investigations. It is not unlikely that chemical irritants, applied to a healthy articular surface, will readily lead to a rapidly-advancing synovitis, and repeated applications of this sort will bring about those progressive changes of which Richet gives so graphic an account. But it does not follow that atmospheric air would give rise to the same disturbances. According to my experience, the dangers of penetrating wounds have been altogether overrated. In the course of the last few years I have attended a considerable number of cases, many of them formidable, and have in every instance obtained satisfactory results. This may have been due, in part, to the healthy condition and tolerably good surroundings of my patients, but not less to the more appropriate treatment that has found its way into surgery. From clinical observation, however, I have received the impression that the synovial membrane has a dangerous affinity for disturbing causes of a constitutional character. Rheumatism, syphilis, and pyæmia, in particular, select this structure in preference to the other components of joints. Of late, much has been said and written about tubercular synovitis; Foerster has never met it, and he is certainly no superficial observer. Nor have I had an opportunity of examining a single case of this description; although I may say, without boasting, that I examine as many cases of joint diseases as any well-employed surgeon. If, moreover, tubercular synovitis is of a nature similar to that of tubercular meningitis, it means little more than initiatory changes in the subsynovial tissue toward suppuration—namely, hyperplasy of connective tissue. Still, I do not pretend to express a conclusive opinion upon what has so sedulously evaded my most inquisitive pursuit.

Some authors believe that the synovial lining suffers most severely from incidental traumatic injuries. I beg to dissent from.

this opinion. If both constitutional and local causes expend their force upon the synovial membrane, all joint diseases would resolve themselves into synovitis, and the other components would pass clear of primary disease. Both clinical and anatomical observation refute views so untenable. Most injuries befall the prominent portions of joints—the bones and their periosteal coverings—because they are most exposed, and because they offer static resistance. And even if the synovial sac comes in for its lesser share, the consequences cannot be beyond speedy redress. Inflammation, excited by a transient cause, would soon terminate in copious secretion of synovial fluid; and this, in turn, would be absorbed. A moderate admixture of purulent elements would not materially affect final resolution. Permanent disintegration of the synovial lining, or of the other constituents of the joint, could not well be ascribed to a comparatively trifling and transient cause.

In the anatomical consideration of joint diseases, there has not yet been assigned to the periosteum that importance which it so fully deserves. In the first place, the periosteum continues as part of the joint from one bone to the other, constituting the so-called fibrous capsule. Next, it partly covers the epiphyses and condyles of the cylindrical bones, and constitutes the means of their maintenance, growth, and development. From the first anatomical relation results the direct transmission of disease; and upon the other depends the structural condition of an essential articular component.

In the course of my surgical practice, I have observed cases of joint disease that could be traced to no other cause than traumatic periostitis. Some of them involved both limb and life. I will relate one in striking exemplification. A lad of thirteen years, in perfect health, and without any noticeable morbid diathesis, was struck with a medium-sized cobblestone at the middle of the tibial crest. Judging from the lesser age of the boy who aimed the blow, from a distance of about twelve yards, the force could not have been very considerable. The impression upon the leg was apparently insignificant. The pain was trifling; and no bruise or indentation appearing, the patient paid no attention to the injury during the succeeding five or six days, and continued at his duty as an errand-boy. Subsequently he

found locomotion impracticable, his leg having become painful and so swollen that he could not get his boot on. A physician was now sent for by the father of the offender. The attendant failed to penetrate the nature of the lesion. Thus twelve days more were irretrievably lost in paltry applications. When better advice was finally obtained, the disease had made considerable advance, demanding more than anything else extensive and deep incisions. These were not resorted to to a sufficient extent. I was called in at about the sixth week after the accident, and found the patient in a most critical situation, and fearfully reduced. Then no alternative but amputation remained, for the limb and the corresponding knee-joint were so extensively and irrecoverably diseased that no attempt at saving the limb could be entertained. The specimen revealed the following state:—Almost entire destruction of periosteum of the tibia; exposure and discoloration of that bone; the remaining portion of the periosteum toward the knee-joint undermined, allowing the passage of a stout probe into the articular cavity at the lower insertion of the fibrous capsule. The latter was itself perforated by ulceration at the external and posterior walls, and the joint exhibited the pathological changes of advanced pyarthrosis. The patient had a speedy recovery, and has for the last six years enjoyed the most unqualified health. Now, gentlemen, this case proves indeed more than I have claimed. Here a lad in perfect health receives an injury at a point remote from the knee-joint, which lights up an inflammation of the periosteum. Not being recognized and controlled, the inflammation proceeded to suppuration; the matter spread below the periosteum in every direction, until it reaches the capsular apparatus, and finds access to the joint. As soon as the diseased structures are removed, the patient regains his former health and strength, precluding every suspicion whatever of constitutional disease. This is certainly a clear case of traumatic periostitis, involving an articulation; and the chain of evidence is continuous from the very starting-point to the finale. This case is by no means so isolated and exceptional as might be supposed, although in others the clinical history may not always be found so plain and transparent.

The foregoing belongs to a class of cases that are generally insidious and protracted. For a long time they cause but little

inconvenience to the patient, and therefore they are slighted at the time when appropriate treatment could scarcely fail to arrest their progress. Thus with very little change they pass on for many months, until an acute period is reached and the joint is found to be extensively diseased. The original traumatic cause is forgotten; it appeared at most to be insignificant, and in the estimation of all parties concerned, could not have given occasion to consequences so severe. Meanwhile the constitution of the patient has materially suffered, the vital forces are depressed, the appetite has become indifferent, weight has decreased, in fact nutrition has gradually and proportionally declined as the local disease has extended its sway. This is the history of most cases occurring during childhood, and it is this class that has been set down as the result of strumous causation, in default of any other known cause.

Now, gentlemen, *must* there not be a *general predisposition* attached to *the physical condition of infantile development*, that favors diseases of joints, and disappears at puberty? No one seems to have paid much attention to this query, and hence the preponderance of joint affections in childhood has remained unaccounted for up to this very day. It is still an enigma unsolved.

Laying aside all the fetters of established doctrines, let us try to find out some of the anatomical differences existing between the joints of children and those of adults. Perhaps they may furnish us the key to a correct understanding of the matter. All we meet is the epiphysal contrivance which serves wise purposes in the growth and development of the osseous architecture, but allows the epiphyses themselves to be liable to mechanical derangement. We need but to look at a vertebra, composed as it is of seven different pieces held together by cartilaginous disks and periosteum. By this arrangement it is rendered a very elastic body, capable of accommodating itself to many exigencies. But its resistance is limited to its elasticity, and the single pieces may under certain circumstances become disjointed or somewhat altered in mutual relation. Diastasis is a solution of continuity solely appertaining to the period of childhood.

At an early stage of infantile life the different epiphyses of the skeleton present a marked peculiarity in the mode of their maintenance, and there is reason to believe that this mode partially

continues to within a short time before puberty. Careful injection of the nutrient vessels of the bones of infants and children, demonstrate pretty clearly that the epiphysis receives no vascular complement from that source. In fact the vessels pass only to, and not through the epiphysal cartilage. On the other hand, the vessels that enter the epiphysis have no communication with the nutrient artery of the shaft. They are, as it seems, completely isolated from each other by the cartilaginous disk. Most epiphyses are supplied with blood from the periosteum, with which they are in part covered. Those epiphyses to which the periosteum cannot approximate closely enough, have a special source of nutrition. Thus for instance the head of the femur receives its supply from a branch of the obturator artery, which enters the notch of the acetabulum and accompanies the so-called ligamentum teres to its destination. The nerve takes the same course. A rather complex mode exists at the knee-joint through both periosteum and the ligamenta cruciata. After the skeleton has attained its full development, and the epiphyses have become continuous with their respective bones, nutrition is perfected by anastomosis of the several vessels. But the intermediate parts of some bones seem never to achieve a full share in nutrition; thus we know that fracture of the femoral neck but rarely heals by bony union. It is very necessary that we become fully acquainted with all these physiological facts, as they serve to throw light upon a field hitherto obscure.

The epiphyses constitute the most prominent part of the joints, and receive most of the violence of traumatic injuries, the soft parts being thus in a measure protected. At the limited space of contact with the offending force, the integuments and the periosteum are contused and ecchymosed, and the nerves of the joint less or more injured. The integuments may soon recover; at any rate their structural derangement would be of but little consequence. Not so with the periosteum. If the extravasation of blood takes place in the usual way, that is to say beneath the latter, it constitutes in my estimation a serious trouble. Irrespective of ecchymosis, the eventual cause of subperiosteal suppuration, the very presence of blood denotes disruption of the vessels intended to supply the nutritive demand of the epiphysis. The extent of the part borne by injuries of articular

nerves (sensitive and trophic) in exciting articular diseases has as yet not been clearly ascertained. A case previously detailed gives strong evidence to this effect. The same injury to any other part of the bone might be comparatively harmless, and would generally eventuate in exfoliation, because the nutrition of the bone depends only in part on the periosteum. It would seem therefore that even apparently trifling contusions at the epiphysis should be viewed with deference and treated with becoming care. But if they give rise to subperiosteal suppuration, there is in two ways imminent danger for the joint:—first, by the matter spreading below the periosteum and forcing its way into the articular cavity; and secondly, by instituting necrobiosis of the epiphysis in part or *in toto.*

The latter mode is obviously the more frequent. The destruction or detachment of the entire epiphysis by this process is very rare; more frequently one of the condyles is implicated, enlarged, osteoporotic, and very tender. From thence the disease radiates to the remaining structures, and thus the joint becomes compromised. I have but lately exhibited to the New York Pathological Society a specimen illustrating this process. A small sequestrum in the internal condyle of the femur was evidently the proximate cause of the extensive trouble to the joint, amounting to an almost complete obliteration of its cavity by adhesive synovitis.

Primary diseases of the epiphysis are not of frequent occurrence, and least of all osteomyelitis.

The process of gradual destruction is most simplified at the hip-joint, and its varied phases may best be studied there. A few anatomical remarks will be necessary. The ligamentum teres must be accepted as a ligament in an anatomical point of view, on account of its being endowed with a considerable complement of fibrous structure. Besides this, however, areolar tissue and fat enter largely into its composition, encompassing the nerves and vessels passing to and from the head of the femur. No anatomist has as yet been able to demonstrate the office of the round ligament. The head of the femur fits so accurately in the acetabulum that it is held there by atmospheric pressure, or, as others think, by cohesion. This bone may dislocate in any direction without the ligamentum teres being ruptured; it con-

sequently places no restraint upon the movements of the thigh bone. Some instances are known where the joints lacked it altogether, without marked impediments resulting. Again it has been ruptured in the act of violent dislocation, and the returned head of the thigh bone moved almost to the same perfection as before. Thus it would appear that this ligament bears no part in the action of the hip-joint. Another office must have been assigned to it. To all appearance it acts as the protector of those nerves and vessels which form the nutritive apparatus of the head of the femur. Without this protection the nutrition of the femoral epiphysis could not be effected. Collectively, I look upon the ligamentum teres therefore as the essential nutritive appendix of the head, and its destruction during the epiphysal period as tantamount to the destruction of the head itself. From the composition of the round ligament a high degree of susceptibility must be inferred. In fact, none of the articular components can bear any comparison to it in this respect. Besides, the ligamentum teres is subject to contusion from violence to the great trochanter, whilst the thigh is in the position of adduction and eversion. And upon the trochanter falls are generally received. Boyer has already expressed the belief that morbus coxarius emanates from the round ligament; but, for want of pathological facts, he did not succeed in convincing his contemporaries. The scrofulous theory very soon preponderating, overawed his views, which well deserved consideration. Perhaps no articulation has suffered more from the dogmatism of the humoralist school than the hip-joint; and the fiction culminated into a system in morbus coxarius. There were explanations in it for every single symptom. Very few of these are destined to survive the present century.

It cannot be denied that morbus coxarius may possibly be caused by primary synovitis or periostitis, with subsequent centripetal perforations. But the majority of cases must necessarily result from primary disintegration of the round ligament. Among the reasons for this opinion, of which I have already enumerated a few, stands in the boldest relief the pathological fact, that the round ligament is invariably destroyed at a time when the remaining components of the joint have suffered but moderate disintegration. Next comes the striking fact that the

head of the femur is invariably reduced eccentrically in size, and in a few exceptional instances thrown off *in toto*. That the origination and frequency of morbus coxarius in childhood has the closest connection with the epiphysal construction, admits of no doubt in my mind; and it explains satisfactorily the comparative rarity of this affection during adult life, when the epiphysis is completely united with the shaft, its nutrition thereby perfected, and the liability to accident lessened.

Gentlemen, I shall here close my discourse on the pathology of joint diseases, and not inflict upon you a reiteration of all that is said better in the works of Sir Benjamin Brodie, Rokitanski, Paget, Gurlt, and other distinguished pathologists. Moreover, the practical benefit of being thoroughly versed in the ulterior structural changes attending joint diseases, is indeed of questionable value. If you see one joint in the last stage of its malady, you have seen them all, so little difference between them is presented. My chief object has been to acquaint you with the initiatory changes of joint diseases, and thus lead you in a practical direction for the prevention of their destructive advancement. But even in this, I have had to consult brevity and terseness, in order best to utilize the limited time at my disposal.

CHAPTER XV.

CLINICAL CHARACTER OF JOINT DISEASES.

General symptoms. — Pain, inflammatory and reflexed. — Immobility. — Spasms. — Contraction. — Malposition.—Fever. — Protracted course.— Synovitis.—Effusion.—Loss of contour.—Fluctuation.—Suppuration.— Perforation.—Hydrops articuli.—Penetrating wounds.—Periostitis and ostitis.—White swelling.—Affections of the knee-joints.—Morbus coxarius.

ALL joint diseases have some symptoms in common. Of these, pain is the most prominent; usually the first to appear, and the last to disappear. Clinical observation discerns two kinds of pain—one emanating directly from the diseased structure; the other proceeding in a circuitous manner from the spinal cord, and manifesting itself in parts not directly connected with the affected articulation.

The former is known by the term of *structural* or *inflammatory pain;* the latter as *reflex.* The structural pain varies in extent, intensity, and duration, according to the tissues implicated, and to the nature and extent of the malady. In some instances the pain may occupy but a small and circumscribed place; in others it may be diffused over the entire articulation, and extend even beyond it.

Its intensity may vary, from the sensation of heat and soreness, to the degree of burning, lancinating, and pulsating; and be equally variable in its continuance.

The morbid condition of the affected structures does not always furnish a satisfactory explanation of the degree of pain; but too often one is out of keeping with the other. Thus, for instance, a mere ephemeral rheumatic synovitis, and in hysteric affections, the pain for the time being is very intense and largely diffused; whereas in hydrarthrosis but little inconvenience to the patient arises from a similar source. The general affection of an entire articulation, with advanced disintegration of the various

tissues, may exist for months, and yet be attended with comparatively little suffering; whilst, on the other hand, affections apparently trifling may create a storm of symptoms and intense agony.

In structural pain, therefore, but a conditional semiotic importance can be attached. In this respect the same axiom rules as in the healing art generally—"that but the congruity of symptoms is the base of diagnosis."

Notwithstanding all this, some general rules can be recognized as a guide at the bedside:

1st. The structural pain is commonly proportionate to the nervous endowment of the tissue affected.

2d. The pain increases and diminishes in proportion to the progress and regress of the disease.

3d. The pain is rendered more intense by false position of the articulation.

4th. The pain increases when the affected structures become subject to centrifugal distention by effusion of whatever composition, and to irritation by pus, loose sequestra, and foreign bodies.

5th. The pain is augmented by touch and motion.

6th. Whatever induces and increases pain, hastens the advance of the articular disease, and *vice versâ*.

The so-called reflex pain is obviously of a neuralgic character. Being excited by the local disturbance, the morbid impression is conveyed to the spinal cord, the common centre of irradiation; thence it is reflected backward to the muscles appertaining to the affected joint, and sometimes to the next articulation; as, for example, the almost pathognomonic pain at the knee in coxalgia.

The latter mode is rather an exception, and an isolated clinical fact, which may be explained in this manner: "that the same nerve (obturator) supplies both joints with sensitive fibres, warranting the supposition of irradiating in the closest proximity."

From the fact that the reflex pain occurs commonly during night and the sleep of the patient, it must be inferred that the trophic or ganglionic province is principally if not exclusively involved. Bnt a few exceptions have come to my notice, to which I shall refer in due course. You are perhaps aware that

I was the first observer of the reflex pains; at all events, I was the first who called attention to them, and explained their character and operation. Perhaps they might have escaped my observation as well, had I not for a time shared the same roof with patients of this class, and had not thus an opportunity been afforded me for studying this singular symptom in all its bearings.

One night, after having left my patients profoundly asleep, with the lights lowered, my attention was suddenly attracted by a peculiar shriek emanating from the sick-room. Within half an hour the shriek was twice repeated.

Though well acquainted with the different voices of my little patients, I could not discern to whom the cry belonged. It was in so peculiar a note, high, shrieking, and short, commencing with a full intonation, and terminating as abruptly. In entering the room I found everything and every one as quiet as I had left them shortly before. The only noticeable change was an acceleration in the breathing of one of the patients.

Whilst thus contemplating and watching him, he again uttered the same shriek, rose into a sitting posture, rubbed his eyes, stared around with a terrified expression, and sunk back upon his bed, continuing his scarcely interrupted sleep. In another ten minutes this scene was reënacted, with almost the same concomitants. During several of these paroxysms I observed a peculiar quiver of both the adductor and flexor muscles of the thigh. The rest of the joint was evidently disturbed by it; and the pain accompanying the quiver must have been of an agonizing character, for the patient automatically grasped the affected limb, as if to arrest the involuntary movement. His rest for the balance of the night was disturbed by moanings, and repeated attempts to change his position. I found the aspect of the patient much changed on the following morning; he looked pallid, haggard, and prostrate; he was of morose and irritable temper, his pulse excited, and his appetite indifferent. The tenderness of his joint had signally increased. Whilst the abduction was more difficult and painful than before, the entire group of the adductor muscles was as tense as if possessed of tonic spasm.

In continuing my observations for successive years, I have seen this very symptom in almost every aggravated case of joint

disease in structural affections of the spine, and in acute periostitis in the proximity of joints. In all these cases it is invariably of the same type, though varying in intensity. The greatest violence of reflex pains we observe in morbus coxarius, and in affections of the knee-joint.

It is rather remarkable that the patients thus afflicted do not remember these nocturnal pains, and that the shrieks of different patients are almost invariably of the same note and duration.

It may well be said these shrieks are as characteristic of joint disease, and as important in its diagnosis, as the peculiar croup tone in diphtheritic laryngitis, and the cries of a parturient woman in the last period of confinement.

As already remarked, these reflex pains occur almost exclusively during the night, and whilst the patient is dormant.

In a few exceptional cases, however, I have met the symptom under inverse circumstances. In one case (Schindler) the pains continued for several days and nights, and kept the affected member, with but short intermissions, in a constant state of clonic spasms, and until the flexors of the leg had been divided.

They may be met with, irrespective of time, when contracted muscles are put upon the stretch.

Whenever the reflex pains prevail, the patient suffers most severely; loses flesh and appetite; becomes anæmic and prostrate, and the disease of the joint progresses with marked rapidity.

According to my clinical experience, the reflex pains chiefly accompany bone diseases, and in these they are most severe. In synovitis they are certainly much milder, if at all present.

In some instances, the reflex pains assume the character of genuine neuralgia, and follow the course of the principal nerves; in others, they discharge their violence upon certain groups of muscles, painfully oscillating and cramping them, leaving them in a state of cataleptic tension.

With the symptom of reflex pain, two others are very soon ushered in:—

1st. *Attenuation of the affected member.*

2d. *Muscular contraction.*

The wasting of the affected extremity is as common a symptom of articular diseases as it is conspicuous. The adipose tissue

becomes rapidly diminished, and finally extinct; the muscles lose their bulk and normal contour, the bones lose in circumference and length; the extremity assumes a cylindriform shape; its growth is arrested; the animal heat is below the standard of the body, and in cold weather the extremity presents that mottled appearance which is so common in paralysis.

The symptom of attenuation is co-ordinate with that of muscular contraction, and never observed without the latter.

Among the many hypotheses advanced in explanation of this symptom, that of Barwell is about the most superficial, ascribing it to the permanent compression of the capillaries within the muscular structures. At best, this theory would apply to the waste of muscles, but leaves the other structures of the extremity out of account.

Without entering into a digest of the various opinions, I shall content myself with offering my own. It requires, indeed, no great pathological acumen or diagnostic sagacity to reduce that symptom to its proper source. It consists not only in the diminution of substance, but the arrest of growth is so prominent, that impeded innervation and impeded nutrition must be charged with the mischief, for which pathology furnishes ample analogy.

In club-foot, for instance, the very same conditions prevail, the same attenuation, the same arrest of growth and development, the same reduction of temperature, coexisting with muscular contraction and malposition.

The muscular shortening in joint diseases is well known to careful observers, but its pathological character has as yet not been fully appreciated by the profession. In carefully analyzing the facts in the premises, I shall encounter no difficulty in establishing views fully consistent with the nature of the symptom in question.

1st. I have already adverted to the influence of the reflex pain upon certain muscles appertaining to the affected articulation, setting them into a most agonizing quiver. This symptom is, indeed, so common, that its peculiarities may be ascertained beyond a shadow of doubt.

2d. When these muscular spasms subside, they leave its structure in a state of rigor, or stationary retraction and tenderness, which, however, gradually disappear if no new spasms set in.

3d. Every attempt at elongating the so retracted muscle, by gradual extension, is very painful, and not rarely it is resisted by returning spasms.

4th. Faradayism renders the state of so retracted muscles still more tender, and not seldom gives rise to greater and painful shortenings of the muscular belly.

5th. During anæsthesia the muscular retraction relaxes and allows full extension, which, in some instances, may be successfully perpetuated by appropriate appliances. In others, the retraction reappears with the cessation of the anæsthetic effect; the muscle remains tender and jerking. If, under these circumstances, the extension be persisted in, the articular disease becomes aggravated.

6th. Persistent retraction terminates in structural changes of the muscle, and destroys its expansibility, both physiologically and experimentally. Faradayism produces scarcely any excitation whatever, and chloroform anæsthesia exercises no marked influence upon its tension. Thus the muscle, having attained its maximum of contraction, and that contraction being rendered permanent by organic changes of its structure, the term contracture has been fitly applied to that condition.

Dr. Benedict, of Vienna, maintains that a constant galvanic current possesses the power not only to reduce the contraction, but to establish the physiological expansibility of muscles so affected. I have, however, not seen a single case at his clinic in the general hospital of that city that could be accepted in proof of his views.

Nor can the successful *brisement forcé* without myotomy pass as evidence, since the violence generally employed is quite sufficient to tear asunder all resisting structures—myolemma or muscular fibres—thus virtually accomplishing the same results as would be produced by dividing the contracted muscle.

7th. The subcutaneous division of the contracted muscle overcomes both resistance, spasm, and attending pains.

8th. The division of contracted muscles exercises the most beneficial influence upon the affected extremity, in promoting its nutrition, growth, and development. Even the muscles themselves become more bulky and susceptible to the action of Faradayism.

The contractures of muscles force of course the affected extremity into a position corresponding to their respective traction, and they become therefore the source of malpositions.

In all joint diseases some muscles, or group of muscles, are invariably contracted to the exclusion of others. Thus, for instance, in morbus coxarius, we find the adductor muscles of the thigh, and some of the flexor muscles, materially shortened. Among the adductors, the pectineus; and among the flexors, the tensor vaginæ femoris, are the most implicated. In consequence of these contractions, the affected extremity is unduly flexed, and adducted and rendered apparently shorter than its fellow, the disparity being increased by the elevation and rotation of the corresponding side of the pelvis. In affections of the knee-joint the biceps muscle is commonly the only one contracted, and but exceptionally the remaining flexors become involved. Hence the affected member is more or less flexed at the knee-joint, and in the higher degree of flexion the leg is rotated on its longitudinal axis, and the toes everted. This position implies an anatomical derangement of the respective parts of the joint, the external condyle of the tibia receding, and the internal protruding in front of the joint. In affections of the tibio-tarsal and tarsal articulations, the peronei muscles are retracted, and thereby the foot rotated so as to give it the position of talipes valgus. In affections of the wrist-joint we meet with contractions of the flexor radialis and ulnaris, with abnormal flexion of the hand; sometimes but one of those muscles is shortened, and the hand has a corresponding leaning in its direction. In affections of the elbow-joint the biceps muscle and the pronator teres are involved, keeping the forearm in a state of pronation and flexion. In affections of the shoulder-joint we notice the contraction of the pectoralis major, with adduction of the arm to the body, etc.

It is self-evident that the contraction of certain muscles in certain joint diseases is by no means accidental, but governed by the supply of coördinate nervous fibres. Schwan, by his very careful and minute dissections, has fully established the fact that such a coördination of nerves exists, supplying joints and muscles. And Hilton, another reliable anatomist, has affirmed that anatomical arrangement. But even without these anatom-

ical facts, clinical observation would be justified in such an inference.

In most joint diseases there is more or less immobility. To a certain extent the immobility is of a voluntary character, employed by the patient to obviate the pain caused by the exercise of the affected joint. Frequently, and in advanced cases, the immobility may arise from hydraulic pressure upon the articulating surfaces, by effusion into the joint, as may be seen in the second stage of hip disease, and in some affections of the knee-joint with unyielding and thickened walls.

The deposits of osseous material around the joint, and osteophytes, will produce the same effect. Muscular contractions are a material impediment to the mobility of affected joints.

I have already referred to malposition of the respective affected articulations, as one of the general symptoms attending articular diseases, and adduced its most prominent cause. There are, however, other causes which occasionally bring about that result. One of them is the gradual disintegration of the epiphysis. Next, the separation of the epiphysis, and its dislodgment from the shaft. Another, the fracture of the epiphysis eventuating in joint disease. The last, though not least, is effusion within the articular cavity. The experimental injections into joints made by Weber and Bonnet, demonstrate that liquids forcibly thrown into the articular cavities through an aperture of a stationary bone, will force the movable part of the joint into certain positions denoting the greatest capacity of the articulation.

Similar changes in the position of joints are produced in the living body by effusions.* But in order to accomplish this, the walls of the articulation require to have been rendered unyielding to the process of inflammation, in which case the effusion acts like a wedge driven between the articular surfaces. As long as the walls remain flaccid, or retain their healthy elasticity, an immense quantity may be accumulated in the joint without any effect upon its position, as is the case in ordinary hydrarthrosis.

Last, I have to mention fever, as one of the common symptoms of joint diseases. This symptom is merely of temporary duration, and accompanies only the higher grades of these affections,

* Collateral with more or less perfect immobility.

their inflammatory periods, or at times when a mighty local irritation exists, be this through foreign bodies, sacculated pus, or the like. It generally subsides with the removal or alleviation of the local disturbance. In all these instances the fever is strictly symptomatic. Rheumatic affections of joints are, however, ushered in with marked febrile excitement, which seems to form an essential part of the morbid process.

Profuse and continuous suppuration of joints is mostly attended by hectic fever, which presents the usual characteristics. But rarely do we meet with pyæmia, caused by affection of the joints. I do not think that I have seen more than a dozen cases in all my practice. The latest refers to a little girl, eleven years old, of very delicate constitution. From causes unknown, she was attacked almost simultaneously with an affection of the left tibio-tarsal joint, and periostitis of the corresponding tibia, both disorders eventuating rapidly in suppuration. A few weeks after the first attack, a large abscess had formed, during one night, at the left hip; another soon afterward made its appearance below the right clavicle, soon to be followed by a third, in the right hip.

It is yet doubtful in my mind, whether this case does not come under the head of spontaneous pyæmia, a form which is seriously doubted by some authors, or whether pyæmia resulted from the original affection.

The division of joint diseases into acute and chronic forms is rather inappropriate, because artificial. It is apt to confound the character of the affection, and has no practical value in any respect. Whether the duration of the malady or the violence of the symptoms is the principle of division, we shall find neither to be tenable.

Almost every joint disease assumes *a protracted course*, and is thus essentially *chronic*. But few exceptions can be adduced to this rule. Rheumatic synovitis may be of short duration, and characterized by violent symptoms, but joints thus affected will require months to recover their normal status. On the other hand, we observe periods of acuity in the most chronic and protracted joint diseases, which may challenge the most acute forms known.

I suggest, therefore, to drop a clinical dogmatism, worthless to the experienced surgeon, and confusing to the novice.

The symptoms by which *synovitis* is characterized materially vary, both in duration and intensity. We need scarcely adduce the general symptoms of this disease, having already alluded to them on a prior occasion.

The chief and pathognomonic phenomenon is *effusion within the articular cavity*, and rapid change in the contours of the joint. From the physiological character of the structure, effusion should *à priori* be expected, as clinical observation substantiates it.

To speak of a *dry joint* in these affections is an absurdity. The most insignificant irritation of the synovial lining is attended with *copious secretion* of a fluid, with the peculiarities of synovia. The higher grades may not exhibit the same quantity of morbid secretion, but enough to give definite fluctuation. The liquid is of a more plastic nature, contains blood-corpuscles, flakes of fibrin, fat globules and epithelium, and becomes early contaminated by the organized elements of pus. To a certain extent the composition of the synovial fluid may still be recognized by the abundance of alkalies and the soapy feel.

In the highest grade of synovitis, the synovial lining is, as you are aware, converted into a pyogenic membrane, and presents the structure of granulations, as stated in the preceding section of our discourse. Under all these conditions there is more or less morbid effusion. The dryness of articulations cannot be denied, but it is noticed in conditions of a different character, and independent of inflammatory affections of the synovial lining. Thus, for instance, it complicates progressive deformative arthritis, which originates in the articular faces of the bones; and though the synovial membrane may gradually be compromised, it is affected in such a manner as to destroy its character as a secreting structure.

In white swelling, the synovial membrane sometimes presents the peculiarity of dryness, but from anatomical changes of a pulpy character, not the result of direct inflammation.

In pure synovitis we never observe consecutive intumescence, infiltration, or hardening of the surrounding tissues; and never to such an extent as we find it in diseases of the periosteum and the osseous structure, unless indeed the latter have become involved.

In the more active forms, there is intense pain within the

whole joint, with consecutive febrile excitement; but reflex pains are moderate, and the spastic oscillations never very intense. In the lower grades of synovitis (hydrarthrosis) these symptoms are entirely wanting, and the patient suffers scarcely any other inconvenience than the effusion within the joint would naturally occasion.

The affections of the periosteum and of the epiphyses are attended by a widely different group of symptoms. The beginning of these diseases is *very insidious*, and their development so slow as to require months to assume a noticeable form. But little pain attends the initiatory period. The whole trouble marks itself *as weakness* of the limb, dryness and *stiffness* of the joint, with inability to use the extremity in the morning. For a time the contours of the joint suffer no change; and if there be any fulness at all, it is more generally diffused, and extends beyond the limits of the articulation. There is no discoloration of the integuments, though there is frequently that *waxy whiteness*, the result of œdema; whence the term "white swelling." The latter is often the first symptom which attracts attention. Though the patient may have the sensation of heat in the affected parts, it is not *objective* either to the hand or thermometer. The patient may gradually experience some difficulty in using the articulation to the fullest extent, feel induced to spare the extremity in locomotion, and thus favor certain positions as a source of greater comfort; malposition is superadded only at a later period.

The *advance of the disease* is marked by progressive swelling of the periarticular structures: the contours of the joint disappear, not from effusion within the articular cavity, but from infiltration of the surroundings, and therefore no fluctuation can be discerned.

Contemporaneous with the enlargement of the articulation, the original feeling of soreness increases to aching pain, being augmented by pressure and locomotion; the rest becomes disturbed by reflex pains, and the limb forced into a position over which the patient loses all control. Every attempt to alter the same is attended with aggravated suffering.

When the swelling and firmness of the soft parts still more increase, then the pain assumes a torturing character. The limb attenuates and becomes cooler, whilst the swelling shows but a moderate addition of temperature.

In viewing the affected extremity, the contrast between *the waste* of the limb, and the *general enlargement* of the articulation, with its numerous distended veins, is strongly marked; and it is this form of articular disease which in times past was designated as *fungus articulorum, tumor albus, and white swelling.* It was thought to be of malignant growth, and amputation its only remedy.

Thanks to the progress of pathological anatomy and the material aid of the microscope, this error of our ancestors has been effectually dispelled.

Nowadays, white swelling has been recognized as an affection of the articular ends of bones, and their respective periosteum; with subsequent periarticular infiltrations of seroplastic material, with its attending organization into fibroplastic cells, fibrous structure, fat, etc. And surgery offers the means of relief as long as the pathological changes are susceptible of reduction.

The knee-joint is most frequently visited with this disease, and it is there one can best study its different phases.

On a former occasion I have assigned the reasons why this malady attacks the knee-joint more frequently than any other, and likewise why the disease is more frequently observed in childhood than in adult age, and therefore need not recur to that subject.

I shall now confine my remarks to the discussion of some features that characterize the process under consideration.

One of these points is the extraordinary slow advance of the disease. Some authors think that a low grade of nutrition of the structures primarily involved offers an acceptable explanation. On close reflection we shall find this view inadmissible, and contradictory to analogy. Nutrition in childhood is more exuberant than at any later period. In the former, maintenance is not the only object of the nutritive process; it is enhanced by growth and development, demanding more ready supply, and meeting with the most elastic condition of the vascular carriers of that supply. In these advantages the infantile skeleton participates to a higher degree than the other systems of the organism.

Hence, from a physiological point of view, we have to reject the advanced theory.

In questioning analogy, we notice facts which demonstrate beyond a shadow of doubt the prolific character of nutrition in the osseous system of children. Fractures consolidate more rapidly with them than with adults; artificial joints are scarcely ever observed during the period of evolution; if periostitis has laid bare the bone of a child, exfoliation rapidly ensues, and sequestra form much more quickly than at a later period. These facts coincide with the experiments of Flourent and Wagner, and dispose effectually of the before-mentioned hypothesis.

In all those cases of white swelling that I have had the opportunity of anatomically investigating, and they have been numerous, I have observed that there is always in one or the other condyle an insular disintegration of the cancellated structure, in which sometimes a small sequestrum is imbedded* (Fig. 53). Under the microscope scarcely any trace of the vanquished structure can be discerned. The chief element is fat. But in the neighborhood of this pathological focus, hyperæmia, traces of fungoid granulations, and osteoporosis, are noticed. This condition explains satisfactorily the proximate cause of the pathological changes inconsistent with the active process of ostitis. In some rare instances, however, the healthy portion of the bone surrounds the disintegrated isle with a sclerotic capsule, by which the affected portion becomes, as it were, isolated and rendered innocuous, in a similar manner as foreign bodies encapsule. This pathological condition may not cover all cases which pass under the name of *tumor albus*, but certainly this is the most prevalent.

FIG. 53.

There is a specimen (Fig. 54) in my collection of the lower third of a femur of a young girl, not exceeding fifteen years of age. She was admitted to the Brooklyn Medical and Surgical Institute with all the symptoms of white swelling, comprising the articulation and periarticular structures; the swelling, however, likewise involved a portion of the femur. The local dis-

* Specimen of the femur of a boy nine years old, derived by amputation in the lower third of the thigh.

turbances were as intense as were the nocturnal pains and the spasms of the flexor muscles. The knee was of course drawn to a right angle.

From the history of the case, and the clinical character of the disease, *circumscribed osteomyelitis*, with its termination in abscess, was diagnosed; and in view of her reduced constitution, and the copious discharge of matter from the neighborhood of the joint, amputation was deemed expedient.

FIG. 54.

The condition of the specimen fully confirmed the diagnosis. There is a large pyogenic cavity at the lower end of the femur, which opens at the posterior aspect of the bone by an irregular aperture not less than an inch and a half in diameter, in the circumference of which the periosteum is raised up, and its internal surface covered with new bone. The epiphysis is somewhat loosened from its attachment, and in time would have become separated.

The original focus of the disease had been obviously limited to the cancellated structure, and rather remote from the joint; but its consecutive effects had extended over the joint, and involved its soft surroundings. There may be still *other exceptions* from the anatomical prototype, but their numerical proportions scarcely affect the statistics.

The adherents of the tubercular theory may rejoice at this pathological admission of mine, of those insular and circumscribed pathological foci, which they may claim as *bonâ fide* evidence of tubercular deposit.

I hold, however, that pathological detritus, limited to an isolated place, cannot, in the eyes of competent judges, pass as tubercle.

If the disease is permitted to spread, it eventuates in perforation of the articular cavity; the formation of external abscesses and fistulous tracts; and the more obstacles the discharge has, the more periosteum will be destroyed, and the bone corroded on its surface.

The protracted development of these phases extends over many

months, and often additional injuries are required to accomplish so extensive disintegration.

A lull of all symptoms is often observed in the like cases to be followed by new exacerbations. A goodly number recover spontaneously, or by appropriate treatment. These recoveries happen not rarely at the period of puberty, at which time the mode of nutrition of the epiphyses becomes perfected.

In analyzing the gradual development of this disease; its preceding cause (traumatic injuries); the comparative moderate effects upon the integrity of the adjacent osseous structure; we find a more passive pathological condition, a direct necrobiosis of the affected structure, more from want of proper maintenance than from active and progressive disease. When active symptoms subsequently set in, they are the efforts of the *vis medicatrix naturæ* to eliminate the detritus foreign to the integrity of the bone. Frequently the detritus becomes absorbed, or pervaded with calcareous elements, and thus recovery is attained.

This gradual change of the osseous structure and annihilation of its nervous and vascular endowments, though limited in extent, renders it intelligible why so little pain is experienced by the patient during the first disintegrating period of the disease. The intense pain that is at a later period superinduced, is evidently connected with the peripheral and active process of ostitis arising in the circumference of the focus. The original disease has nothing to do with it.

The appearance of nocturnal pain constitutes a serious complication, and indicates the commencement of suppuration.

The *contraction* of the biceps muscle is quite common, and the result of reflected spasm. The leg is thus held in an angular position to the thigh, and most usually *rotated on its longitudinal axis*, with eversion of the toes. This position goes *pari passu* with an anatomical derangement of the joint itself. The patella rides upon the external condyle of the femur, and is generally adherent; the internal condyle of the tibia projects in front, whilst the external one recedes.

The contraction of the biceps is exclusively accountable for this malposition, for at a certain angle it acts as a rotator, when not *counteracted* by the simultaneous contraction of the internal hamstrings.

I have but lately exhibited to the New York Pathological Society a specimen of this kind, and the action of the biceps is so undeniably demonstrated, that there is no more room for further speculation to account for the symptoms.

For a long time the mobility of the affected joint remains, if not impeded by the contraction; but when synovitis is superinduced to the original affection, the joint may become obliterated by fibrous adhesions between the articular faces, which may still more impede the mobility; but rarely are there osteophytes passing from one bone to the other, depriving the joint of all vestige of motion. True bony anchylosis is of very rare occurrence, and much more the consequence of penetrating wounds of the joint and high-graded synovitis than of this form of disease.

Whether the disease originates in the synovial membrane, in the crucial ligaments, in the periosteum, or the epiphysis of the joint, the symptoms appertaining to each of them respectively will be so blended in their advanced course as to render diagnostic discrimination almost impossible, leaving the previous history as the only guide.

The pathological conditions of joint diseases vary but little when suppuration, burrowing of pus, has been going on, and the bones have been disintegrated for any length of time; the symptoms attending those conditions are almost uniform in all such cases. The competent and experienced surgeon may yet recognize the pathogenesis of the original disease, but novices rarely realize differences so indistinct and subtile. Thus in caries of the joint emanating from synovitis, the articular surfaces are more generally denuded of their respective cartilaginous coverings, but the osteoporosis does not much exceed the surface; the crucial ligaments are but partially destroyed; the semilunar cartilages partly disintegrated, discolored, and mostly detached. On moving the articulation, crepitus is discernible. If, however, the bone has been the starting-point of the disease, the caries of the articular surface is generally restricted to the originally affected locality, and the cartilage is there and thereabout disintegrated. The crucial ligaments are mostly destroyed *in toto*, and crepitus is less distinct.

The clinical character of *hip disease* will now demand attention, on account of some peculiarities in its manifestations. Morbus

coxarius is about as good a term as could be chosen, and certainly more appropriate than "coxalgia," which applies solely to the pain of the affection.

The first stage of this lesion materially conforms with the same stage of the affections of other joints. The only symptom requiring special mention is limping. It is most noticeable in the morning, less during the day, and least toward evening; most conspicuous after great exertion, and sometimes absent after a day of complete rest. The duration of this period is variable; repeated accidents and the continuous use of the affected extremity may shorten, and constant rest prolong it.

The so characteristic pain at the knee may already make its appearance at this stage; but if so, there will be likewise indications of retracted muscles, with which this symptom appears conjointly. This pain has often confounded the diagnosis of the less experienced, without any need; for you may press and squeeze the knee-joint as you please without the slightest increase of that pain; whereas the pressure upon, and movement of, the hip-joint will aggravate it. The progress of the malady may at this juncture be arrested, and the patient relieved from further trouble.

The second stage is characterized by elongation, abduction, eversion and slight flexion of the affected limb at the hip, with lowering of the pelvis, flattening of the gluteal region, sinking of the gluteal fold, and an inclination of the internatal fissure at and toward the affected side. The mobility of the joint may either be impeded or entirely suspended. Adduction is generally impossible.

For the purpose of locomotion, the patient brings the lumbar portion of the spine and the other hip-joint into play; thereby easily deceiving the inexperienced observer. In the erect posture the spine exhibits a single curve, of which the convexity corresponds with the seat of trouble. The superior spinous process of the ilium is depressed, when compared with that of the other side, and the healthy member is adducted in proportion to the malposition of its afflicted fellow. In walking, the patient places the latter forward and outward, and drags the other limb after it in a rather diagonal direction. All these symptoms, more or less complete, can be ascertained by undressing the patient, dropping a plummet-line from the occipital protuberance, walking, and by

careful examination in the horizontal posture. If the patient sit down in such a manner as to accommodate the affected member, both pelvis and spine assume normal relations, thus proving that the elongation of the limb does not depend on the lateral declivity of the pelvis, as Gross * asserts.

The chief or proximate cause of the entire group of symptoms rests with the immobility of the joint, and the fixed adducted position of the extremity. In imitating them we produce the very same effect.

There can be no doubt that the elongation is but apparent, and not real, as the late Professor Rust, of Berlin, claims. Nor is there any enlargement of the head of the femur, from either tuberculosis or other causes, to which he ascribes the actual elongation. The sole source of the symptom is hydraulic pressure from existing intra-articular effusions. I was led to this view from the analogous position of the femur and the immobility of the joint produced by experimental injection. Acting on this supposition, I have succeeded in substantiating the correctness of my opinion, by paracentesis of the articular cavity. The removal of the intra-articular fluid was followed immediately by returning mobility and the correction of the malposition. This point is consequently settled by demonstrable evidence.

With the apparent elongation of the limb, the structural pain gradually increases, and the reflex symptoms rapidly rise to an intense degree. The nocturnal pains in this period are more violent and torturing than at any later, and for obvious reasons. Whilst the extremity is immovably fixed by hydraulic pressure, the adductor muscles are nightly agitated by reflected spasms, and kept on the stretch. The limb becomes attenuated, and exhibits marked disproportion with its fellow; the constitution, rest, appetite, suffer gravely, and reduce the patient in weight and appearance. The effusion may still be of a plastic and organizable character; sero-purulent, or exclusively pus; may be free from, or contaminated with, structural detritus, benign or destructive. Its composition will naturally determine the issue of the case. If the effusion be mild, plastic, benign, free from deleterious admixture, its partial absorption and final organization into fibrous structure may take place, and thus terminate

* Gross' "Practical Observations." Philadelphia, 1859.

the malady. Or its quantity may lead to a disruption of the capsular ligament, and the escape of the intra-articular effusion into the surroundings of the joint, and there become organized and innocuous. Through similar changes the sero-purulent effusion may pass with the same result.

But if the articular contents are of a destructive character, they may, by macerating and corroding the acetabulum, pass into the pelvic cavity through the cotyloid notch, or through the capsular ligament, and will invariably give rise to the formation of abscess corresponding in locality with the place of perforation.

In the moment the perforation is effected a new series of symptoms appears, and with which the third stage of the disease is ushered in.

The third stage is distinguished by diametrically opposite symptoms. The contrast of the two stages can best be realized by placing them in juxtaposition.

Second Stage.	*Third Stage.*
Affected limb.	Affected limb.
Apparently elongated.	Apparently shortened.
Abducted.	Adducted.
Flexed at hip and knee.	Flexed at hip.
Toes everted.	Toes inverted.
Foot fully on the ground.	Ball of toes only.
Healthy limb adducted.	Abducted.
Pelvis lowered.	Tilted up.
Pelvis projects forward.	Backward.
Pelvis angle of inclination acute.	Almost rectangular.
Nates flattened.	Full and convex.
Gluteal fold lowered.	Elevated.
Internal fissure inclined to affected side.	Inclined toward the opposite side.
Spine curved on the affected side.	Curved toward the other side.
Nocturnal pain very intense.	Greatly diminished.

It will be seen that the third stage is characterized by unmistakable clinical manifestations, and by so peculiar a gait of the patient as to be recognized at a distance.

The shortening, adduction, and inversion of the limb, conjointly with the rotundity of the gluteal space, strongly convey the impression of posterior superior dislocation of the femur. This similarity of the two may have led Rust to presume their

identity, and ascribe to the action of the contracted muscles the cause of *spontaneous dislocation*. The morbid enlargement of the caput femoris (at the second stage) lent a plausible argument to this hypothesis. What was more simple and transparent than that the head of the femur, partially expelled from the acetabulum by its disproportionate size, should leave it entirely, and follow the undue traction of the muscles? This hypothesis of the renowned German surgeon prevailed among the profession; spontaneous dislocation was henceforth a settled fact, against which but heterodoxy could raise its voice. Buehring, of Berlin, if I do not mistake, was the first who took issue with Rust's theory, and attempted to reduce the acknowledged similarity of symptoms to causes widely different from those propounded. In this effort he derived material assistance from the advancement of pathological anatomy. The question, once opened, has received a rational solution. At this present moment there are few well-informed surgeons who recognize spontaneous dislocation. Nélaton has informed us of a good method to decide the relative position of the femur to the acetabulum. In drawing a line from the anterior superior spinous process of the ilium to the tuberosity of the ischium, it passes on its way, from one point to the other, the apex of the large trochanter, in the normal position of the femur. It crosses the trochanter more or less below the apex in dislocation.

In applying this test in the third stage of morbus coxarius, you will mostly find the normal relations of so insignificant difference as to preclude all possibility of dislocation. Irrespective of this clinical fact, the morbid condition of these points contradicts the assertion of Rust *in toto*. It might rather be said that the acetabulum becomes dislocated, since we often find it extending up and backward, in which direction the femur follows; but true dislocations belong to the rarest occurrences. I have searched in this respect the anatomical museums on this and the other side of the Atlantic, without having found more than about a dozen specimens exhibiting the conjoined evidences of hip disease and dislocation. In this statement I am borne out by other inquirers. It follows, therefore, that dislocation is but a rare incident in hip disease, indeed much more so than might be rationally expected, considering the actual state of the joint

in many instances. If dislocation is practicable in a healthy articulation, how much more predisposed must the latter be when the acetabulum is denuded and enlarged, the round ligament totally destroyed, the head of the femur *diminished* in size, the cotyloid cartilage more or less disintegrated, the capsular ligament broken through, etc.; which all tend to facilitate the displacement of the femur! It is thus evident that the slightest appreciable injury should suffice to bring about a dislocation; but its spontaneity cannot be conceived, and must therefore be denied. On the other hand, it must be borne in mind that the joint, being more or less tender, is well taken care of by the patient and protected against incidental injuries.

One of these means is the play of all muscles by voluntary effort to keep the joint at rest, and thus dislocations are prevented which otherwise might seem inevitable. Wherever dislocations take place, there can be no doubt as to their being the result of some injury or other, however trifling. That much I can at least assure, that I never myself have had the opportunity of observing a single case of indisputable dislocation consequent upon morbus coxarius, and I have had my finger in the hip-joint too often to be deceived. If you examine a patient so afflicted with the aid of anæsthetics, extending the affected limb, whilst at the same time exercising counter-extension by placing your foot against the pelvis, you will notice a certain amount of mobility of the joint, but the *absolute impossibility* of abducting it. In searching for the cause, a firm and unyielding contraction of the adductor muscles will be found, over which the anæsthetics seem to have no influence whatsoever. It is thus in the third as in the second stage; the malposition of the limb is produced by a single cause, and the rest of the symptoms follow as physical necessities. Now, for instance, let us presume the femur held in undue position of adduction and flexion, and the patient attempt to walk, he would yield the pelvis as much as possible, for the purpose of relieving the tension of the contracted muscles. The first thing he does is to rotate the pelvis in its transverse diameter, thus approximating the anterior superior spinous process of the ilium, to the insertion of the tensor vaginæ femoris. This accounts for the enhanced angle of inclination with the horizon. By turning the pelvis on its axis at the lumbar articulations, the

patient favors the former object. If the pelvis remained quite horizontal, and the extremity of the healthy side rectangular to the former, the affected limb would necessarily cross its fellow, and locomotion would thus be rendered impracticable. Hence the affected side of the pelvis is tilted up in proportion to the adduction of the affected extremity, the healthy member is thrown out (abducted), and parallelism is thus achieved. If the pelvis is thus out of position, the spine and shoulders have to adapt themselves to the static changes. The correctness of these deductions becomes more evident in cases where the limb is so much adducted as to cross the other, and become useless for locomotion. In such a case the pelvis does not tilt, but remains in normal position (Fig. 55).

FIG. 55.

In compounding the effects of these changes in the position of pelvis and femur, we can almost to a nicety ascertain the amount of apparent shortening, without regard to the so-called spontaneous dislocation. The longitudinal rotation of the pelvis will raise the extremity as much as an inch, the flexion of the femur upon the pelvis another inch, and the obliquity of the pelvis from one to three inches. Thus the limb may be shortened in the aggregate from three to five inches, an amount never to be produced by traumatic dislocation of the femur upon the ilium.

Most cases of morbus coxarius terminate with the third stage; but comparatively a few advance to the fourth and last stage of the disease, which is a combination of the symptoms of the third with those of caries, abscesses, fistulous openings and tracts in the neighborhood of the joint, local pain arising from such sources, and hectic fever.

Thus it will be seen that hip disease is characterized more than any other by a certain immutable regularity and chronological succession of symptoms, which, in themselves, furnish the strongest ground for differential diagnosis. Though the first stage may escape the vigilance of the professional attendant, the second will inevitably decide his appreciation of the growing trouble. The third stage is invariably preceded by the second,

and the fourth by the former stages. This, at least, has been my observation in a large number of cases, and I entertain no doubt that it is substantially the same with other accurate observers. The exceptions that may be adduced appertain to cases partly not hip disease at all, partly hip disease of a consecutive nature, and consequently blended with other pathological conditions.

Periostitis in the neighborhood of the hip-joint often produces similarities of hip disease of a most striking character. We may find in connection with it all the symptoms enumerated under the third stage of morbus coxarius, but this difference will always be manifest: that the symptoms of the second stage never preceded that condition. If the joint is not secondarily implicated in those cases there will be a freer mobility of the same, and no crepitus; whilst, on the other hand, the femur is enlarged and tender.

Sometimes we meet with malposition of the femur in consequence of Pott's disease, and periostitis of the spine which may give rise to an erroneous diagnosis. The history of morbus coxarius and affections of the spine is so differentially marked that the mistake may be easily corrected. Eventually, the application of chloroform will suffice to overcome the muscular retractions of the latter, and prove the hip-joint to be intact.

We owe to Erichsen's careful investigations our knowledge of the suppurative affection of the sacro-iliac junction; but the symptoms adduced by that author are so widely different from those of hip disease, that they hardly can be confounded. Eventually the careful examination of the corresponding hip-joint must necessarily settle all doubts.

CHAPTER XVI.

PROGNOSIS AND TREATMENT OF JOINT DISEASES.

Method of examining.—Importance of anæsthesia for diagnostic purposes.—First stage.—Absolute rest of joints the first axiom.—Means of accomplishing it.—Position of affected articulation the next.—Treatment of penetrating wounds.—Second stage.—Rest and position imperative.—Paracentesis of joints beneficial and harmless.—Treatment of hydrops articuli.—Tenotomy.—Free incisions.—Treatment of morbus coxarius.—Bauer's wire apparatus.—Stiffened bandages.—Portative splints and braces of Davis, Vedder, Barwell, Sayre, Andrews, and Bauer.—Their respective therapeutical value.—Treatment of affections of the knee-joint.—Gutter-splints.—Knee-brace of Bauer.—Third stage.—Exsection and amputation.—Their respective indications.

FROM the preceding remarks of the discourse we may sum up the following prognostic axioms.

From the collective character of joint affections, we must come to the conclusion that they constitute formidable diseases.

In their respective courses they are slow and protracted, often of years' duration.

In their commencement and development they are insidious, and may have proceeded to considerable disintegration of normal tissue before the patient becomes aware of the impending difficulty.

The restitutive powers of some of the articular structures are of an indifferent character, owing to the imperfections of their nutrition.

In as far as the osseous structure is concerned, recovery depends on the gradual destruction of the affected parts, which of course is necessarily tedious.

In most joint diseases the affected structures undergo changes more or less disqualifying them for the performance of their respective physiological offices, thus either impeding or annihilating the usefulness of the articulation.

The suppuration of articular cavities leads to their perforation,

to extensive subfascial burrowing of pus, and not only involves the extremity, but the constitution at large.

Reflex pains and spasms accompanying joint diseases are o the most violent and torturing character, upsetting rest and appetite, placing the very existence of the patient in jeopardy.

Caries of the articular faces may cause so copious a drainage as to gradually bring the patient to hectics, pyæmia, and multilocular abscess in the vital organs.

Finally, malposition, deformity, false and true anchylosis, may terminate these diseases, and disable the patient for the rest of his life.

All this should be borne in mind when taking charge of cases of this description; and our prognosis should be guarded under all circumstances, however slight and insignificant the cases might appear at the first glance, for the objective symptoms are not a reliable barometer of the actual condition with which one may eventually have to grapple.

Notwithstanding all I have said in this respect, the prognosis of joint diseases is infinitely better to-day than it was fifty years ago. The present generation has achieved a clearer insight into the physiological and pathological character of joints than our professional ancestors; it has successfully rid itself of errors, heresies, and notions which obscured the unbiassed clinical understanding of this class of diseases; and since then we have steadily improved in therapeutic efficiency and self-reliance. What was formerly a *noli me tangere*, has become a coveted object of diligent investigation and treatment. And the results of our cherished efforts are in every respect gratifying to our professional pride, and afford reasonable satisfaction to the patients concerned.

It will scarcely be necessary to enter into prognostic details, inasmuch as they may be inferred from the previous section of these lectures, or may be yet especially alluded to under the succeeding heading.

The most important proceeding in the treatment of joint diseases is a thorough and systematic examination, comprising both the antecedents of the patient and the present clinical aspect of his disease. In reference to the former, the state of health of his immediate and remote ancestors should be ascertained, as it might possibly

affect the prognosis of the case. Next to this is the previous history of the patient, whether he has passed through the ordinary infantile diseases without sequelæ; whether the previous state of his constitution and health has been strong and vigorous, or otherwise. It might be as well to inquire into the character of his temperament, mode of living, residence, domestic surroundings, etc., in order to form an approximate idea as to the status and vigor of his system. The next object of inquiry would be the probable causation of the impending disease. In this respect, gentlemen, I should advise to be searching and persevering, for most parents know so little about it, that we are obliged to sharpen their memory. They will assign the most trivial causes, and harp upon the same with great pertinacity, simply because the true occasion is in the past and has slipped their memory, whereas trivialities are brought forth because they happened at a time soon after which the disease assumed form and importance. I have been startled by the simplicity with which even modern writers on the subject have allowed themselves to be stultified with the most innocent and harmless occurrences, as for instance "sitting down on the grass," or "on a cold stone," or "having run about a good deal," etc. I cannot persuade myself that such trivialities can constitute legitimate and reasonably acceptable causes of joint diseases, even if they are printed over the signature of a respected surgical name.

In closely investigating further, you will learn that there have been *traumatic influences* of some kind or other, more or less *direct*, upon the articulation; and if nothing of the kind could be traced, I would not hesitate in assuming the same, if the previous health of the patient had been untainted with manifestations which can be justly ascribed to chronic nutritive derangements and a vitiated domestic atmosphere. That a traumatic accident has by weeks and even months preceded the actual disease is no argument against its injury, since we know from the preceding remarks that more or less time will necessarily intervene between the accident and the disease, to bring about those changes in the structures which can attract attention. Moreover, it is mostly the local pain and the disturbance in the use of the joint before any notice at all is taken, and either of them are but mere remote results.

We may then proceed with a general inspection of the patient; his general appearance; as to the present state of his health, and the actions of the respective systems. If the patient presents pallor, general attenuation, and prostration, you may rest assured that the disease has far advanced, and shaken his general health by the incidental reactions upon rest, appetite, and nutrition.

The patient should then be undressed, so as to obtain a full view of the articulation, and the affected member in general; we ought to note its circumference and position, and compare it with the other extremity; institute locomotion, and carefully observe how the joint is used and the limb is put to an account. If the patient should limp, we ought to determine whether the limping depends on immobility or tenderness of the affected articulation, or on malposition, or deficiency in the length of the member.

In fine, the patient should be placed on a suitable table, so as to be accessible from all sides, and be put under the full influence of an anæsthetic, that volition may be suspended and the rest of the examination be painless. These preparations I regard as essential to obtain a full knowledge of the character and extent of the disease.

I do not deem it necessary to enter into the full details of the examination, with which you are already acquainted. But a few points deserve special attention. In the first place, we have to ascertain the condition of the bones constituting the affected joints, and find out whether the disease has originated remote from the joint, in the periosteum, or in the bone itself. In either case, we shall find by comparison that the circumference of the bone is increased, and the adjacent tissues more or less infiltrated; that its surface is uneven, pressure upon it tender, and by bending the bone we occasionally find that it has lost its elasticity and hardness. We have next to direct our attention upon the condyles; compare their size, elasticity, and sensitiveness with the corresponding condyles of the other limb. Frequent practice will enable us to discern changes which are easily overlooked and ignored by the novice. There is a certain degree of elasticity in the condyles, which is lost by the morbid alterations; even the increased tenderness of the bony structure becomes manifest, though the patient be in anæsthesia. On moving the

joint carefully, we ascertain the degree of mobility and the changes that may have taken place in the articular surfaces. Polypiform growths of the synovial membrane may thus be discovered, when they are too small for the touch of the finger. Crepitus would be the evidence of destruction of cartilage; its absence proves nothing to the contrary, as we have learned on a former occasion. If the joint allows an undue lateral or rotatory movement, we may infer that the lateral or intermediate ligaments have become destroyed, and if combined with crepitus, it may indicate that the articular faces have been materially flattened and changed in form. If the periarticular tissues of a joint are largely infiltrated, and the joint itself is either dry or contains but little fluid, we have the more reason to suspect bone disease, and centre our attention upon the condition of the osseous structure. A distention of the articular cavity without induration of the periarticular structures, indicates synovitis.

But during the anæsthesia, we can ascertain whether the malposition is produced by interarticular adhesion or muscular contractions, or both; and, moreover, whether the contracted muscles still retain their expansibility, or have more or less lost it. If there are sinuses about the joint we must try to discover their course and termination, though they may be very circuitous. I have found pewter and elastic probes more available for this purpose than silver ones; and large probes better than the finer ones. In this way, gentlemen, we shall arrive at a clear understanding of our case, and establish a reliable diagnosis as a basis of therapeutic action.

THE FIRST STAGE is the disease but virtually. The affected structures are but in a state of congestion and hyperæmia, with incident tenderness; there are no substantial changes as yet, and by at once taking prompt measures, we may succeed in obviating future mischief. The earlier this is done the surer we may count on success. Nay more, I should consider myself justified in treating every injury to the joint as a virtual affection of the same. A few weeks' restraint is nothing in comparison with those terrible maladies that may eventuate from apparently insignificant causes. But with all the precautions imaginable, and with the most appropriate and prompt treatment, we are not always able to prevent the consequences, more particu-

larly if they refer to injuries of the periosteum and the bony structure.

The very first therapeutic axiom in the treatment of joint diseases is *rest, absolute* and *unconditional;* and the next, *proper position* of the affected articulation. The efficacy of these two is greater and more reliable than the entire antiphlogistic apparatus, and they generally suffice to meet the exigencies of the first stage.

The affected joint is to be rendered immovable by appropriate bandages, materials, or special appliances; and if the affection concerns the lower extremity it would be additionally advisable that the patient take to his bed, and thus get rid of the superincumbent weight upon the affected joint. The ordinary way of rendering a joint immovable is by hardening bandages, by leather, gutta-percha, wooden, wire, or light metallic splints, that are adapted to the form of the extremity. If the morbid condition of the joint is not far advanced, so that we may not require to inspect the articulation often, and thus disturb the dressing, stiff bandages are certainly preferable; otherwise, splints should be chosen. The stiff bandages are made by impregnating the outer portion of the dressing with flour, starch, or dextrine paste, plaster-of-Paris, or the liquid glass. Inasmuch as these bandages are more or less impermeable to the perspiration, it is necessary to first surround the extremity with a well-applied flannel bandage, under which the unevenness of the surface should be filled with cotton wool. How the rest is done is indeed very indifferent, as long as it fulfils its object. Until the bandage is perfectly dry, it would be advisable to fasten a splint to the member. In some instances it may be advisable, previous to the application of the bandage, to apply an appropriate number of leeches, so as to reduce the hyperæmia and stasis, the effects of which are, however, but transitory. The fixture of the joint should immediately follow. Except in recent injuries, the application of cold is rarely demanded; but if resorted to, it should be efficiently applied in the form of ice-bags, for which purpose one part of the joint may be relieved from the bandage and exposed to the action of that remedy.

The position of the affected joint should be that in which the patient is most comfortable and at rest. It is chiefly governed, however, by the tendency of certain muscles to contract, and

therefore should at once be placed in an antagonistic position. If you remember that portion of our discourse in which I referred to muscular contraction, you will know to choose the position which is most appropriate. In adopting the same, muscular contractions and malpositions will thus be obviated. Some surgeons advise to give the extremity such an angle as will be most conducive to its usefulness. We have nothing to do with that object at this juncture; our object is to relieve the disease, and thus preserve the entire usefulness of the joint; their advice is in place when the joint is about anchylosing. The straight position of the elbow-joint gives more relief than the flexed one, irrespective to the fact that the latter favors the contraction of the biceps and brachialis. And a straight limb bears more vertical weight than a bent one, and may be used to greater advantage in locomotion.

The same treatment holds good in perforating wounds of the joints, with the additional rule that the wound be carefully cleaned, its margins properly approximated and united. In this way I have seen many an incised and punctured wound close by first intention, without any inconvenience whatsoever. Different is it with torn and contused wounds, where the first intention is but exceptional, and suppuration the rule. Immobility and proper position of the joint are likewise the chief indications here, and should be scrupulously observed; but the dressing should circumvent the wound and leave it accessible to local treatment.

In using dextrine, starch, and plaster-of-Paris bandages, that part in the neighborhood of the wound should be protected by a coating of varnish, so as to render it unimpregnable to the discharge.

I rather prefer to secure the immobility of the joint by wire and metallic splints (tin or sheet-iron), inasmuch as they will permit the use of permanent bath, which I consider invaluable in the treatment of such wounds. We owe the introduction of this remedy to B. Langenbeck, to whom surgery is indebted for many and valuable improvements. If suppuration of the joint ensues, you will do the most for the recovery of your patient by giving free vent to the discharge, and by keeping the suppurating surface in a very clean condition. By these means, and eventually by free incisions into the articular cavity, I have saved many a patient.

There is hardly any necessity for medication, unless incidental derangements demand therapeutic interference. The local treatment suffices to check and ameliorate the articular disease; time and patience accomplish the rest. Beyond those local remedies I have mentioned, nothing else is required at this juncture. From painting the articulation with tincture of iodine I have seen no benefit; and fly blisters interfere with the fixture of the joint, cause a needless irritation to the patient, and sometimes give rise to reflexed muscular contraction.

IN THE SECOND STAGE the indications of treatment become more diversified. The pathological character of this period is expressed by structural invasions of a more decided nature; by more copious infiltrations and effusion within the joint; by reflexed pain, muscular spasm, and consequent malposition; and, in fine, reactive disturbances of the constitution.

If the patient has been properly attended to at the first stage, the disease will but rarely advance to the second; and if the local affection was of a nature that could not be checked in its advance by due precaution, the second stage will be at least materially mitigated by the previous treatment.

Assuming, however, that the patient comes under your charge with the full pathological and clinical force of the second stage, the same remedies and appliances commend themselves; for *rest* and *position* are the imperative axioms whilst the disease is in active progress. In this stage the antiphlogistic treatment is resorted to in vain, as long as rest and position of the joint are disregarded, and the limb permitted to bend, rotate, or assume any prejudicial posture. Nay more, the antiphlogistic remedies even fail to give the slightest relief or to alleviate one single symptom; my own personal observation has decided this fact conclusively, and I do not entertain the slightest doubt that other surgeons have met with the same negative results. But in securing rest and position to the affected articulation we almost instantaneously give relief to our patient, and initiate progressive improvements. Having done this, it rests with you whether you deem local depletion and the application of ice or narcotic fomentation additionally necessary. I have but rarely, and I may say but exceptionally, needed them, although I mean not to deny the fact that the distended capillaries may temporarily and usefully

be depleted by leeches, wet cups, and scarifications; the effect of which you have, however, to render permanent, by means of which I shall soon speak.

If the affected member has already been placed in malposition, you have promptly to reduce the same to insure articular rest. This should be done under the full influence of anæsthetics. I consider chloroform better than ether, and equally safe. If I stated the number of chloroform applications that I have made with complete safety, it might be considered as grandiloquy, and as a slur upon professional brethren who have had the misfortune of meeting with fatal accidents. My mind is free from any such intention; I simply state the facts. Yet I cannot divest myself of the impression that many accident cases might have been obviated by the use of a proper and reliable article, by discrimination of patients, and due care by the administrator.

Of all the chloroform offered for sale in the market, I deem that of Dr. Squibb of Brooklyn the best; it is always of the same purity and specific gravity, of the same physical quality and physiological action, and I use it with perfect confidence.

The mode in which I administer chloroform is very simple, although perhaps not economical. I form a coarse towel into a short and wide funnel, with an inch opening at the apex for the free access of air, and look more upon the action of the lungs as indicative, than upon that of the heart. At the very moment that the thoracic respiration ceases, and the diaphragmatic suction prevails, I suspend chloroform inhalation, whether the patient be under its full influence or not. This seems to be the margin of its legitimate use, beyond which the danger commences.

Patients addicted to the copious use of alcoholic liquor, and those that present a leuco-phlegmatic, bloated, and hydræmic appearance, are not fit recipients of chloroform; nor would I deem it safe to administer it to patients with a weak and flat pulse, in whom the propelling power of the heart is more or less impeded by the fatty degeneration of that organ.

It has been my fortune almost always to be assisted by reliable and experienced men, who watched the effects of the chloroform, and did not divide their attention by looking after the

operative proceeding. In a few instances I came near losing my patient by chloroform, and averted the fatal catastrophe only by noticing the impending danger in time. But these mishaps were clearly traceable to that carelessness which arises from the divided attention of the assistant.

The patient being under the full effect of chloroform, we now proceed to reduce the malposition, and bend the limb either in the opposite or intermediate position from that in which we found it. If we meet with resistance, we have to overcome the same by a legitimate effort of physical power. I would not hesitate to break up interarticular adhesions if they offered opposition. If intra-articular effusion opposes the reduction of the malposition, I would certainly perform paracentesis of the joint. If muscular contractions are in the way, I would resort to myotomy or tenotomy.

There are authors who oppose every and all interference with the position of *inflamed joints* as downright meddlesomeness, and as reprehensible surgical practice, and advise *the reduction of the inflammation* as the preliminary step. I apprehend that their advice is actuated much more by traditional fears in interfering with inflamed articulations than by experience.

Unless I were permitted to adopt that plan, I would decline all responsibility attached to the treatment of any joint disease.

I have already stated that antiphlogistic remedies have very little effect upon the inflamed structure of a joint, and none whatever if the articulation is permitted to be disturbed in its needful rest by the jerks of the patient, or the spastic oscillation of irritated muscles.

If, under such circumstances, and under the purely antiphlogistic treatment, the disease becomes arrested, it is in spite of, and not by virtue of such treatment, and probably has been protracted thereby. I could prove this by uncountable cases, and produce the individual patients to prove the facts by their own stories. But such evidence is scarcely needed to gentlemen whose own store of experience will furnish them with sufficient affirmative facts.

No one will deny the beneficial results of relieving an inflamed articulation of its morbid product, provided that the process of removing the same does not entail additional danger. Mr. Bar-

well does me the honor of eulogizing the operation which has benefited so many of his patients.

That the operation, if properly performed, is harmless, I shall prove to you on a future occasion.

The division of muscles for therapeutic and orthopædic purposes in joint diseases has met with an unfair adjudication. Barwell, Davis, Prince, and other writers on the subject, are *in toto* against this operation ; they hold that extension is quite sufficient to control the spastic affection of muscles agitated by the reflexed effects of joint diseases. My experience in extension in the affections of joints is certainly not inferior to any one of these gentlemen, and perhaps not inferior to them collectively. I say so with due respect to the literary merits of these authors. And I can bring forth, if required, the very proofs of Dr. Davis' error by cases which he had treated by extension for months in succession, and in his very establishment, without subjugating the muscular resistance.

Need I state to you that I have availed myself with avidity of all suggestions and means promising aid and comfort to this class of my patients? And it would surely be a source of gratification to me if I could consistently and truthfully acknowledge my professional indebtedness for information, valuable or practically useful. As it is, I am impelled to state that I have derived little or no benefit from extension *per se* in the treatment of progressive joint diseases. Whatever benefit I have derived from it at all, is unquestionably due to *its collateral effect upon fixing the affected articulation.*

The collective experience on this question I can sum up in the following aphorisms.

1st. Extension cannot part the inflamed articular surfaces, for which it has been erroneously designed by its author.

2d. Powerful extension is perhaps the promptest remedy against an ephemeral muscular spasm, as every one has experienced with himself if he has happened to be suddenly attacked by spasms of the muscles of the calf; but it cannot be relied on in persistent spastic agitations of the muscles.

3d. In many instances, extension will not only fail to relieve the spasms, but will react unfavorably upon the violence of the existing joint disease, if persisted in.

4th. The division of the contracted muscle is the surest and unfailing remedy.

The most violent periods in the course of joint diseases I have observed in consequence of keeping a retracted muscle on the stretch, and nothing short of division would give relief, though many things and the most stringent antiphlogosis were vainly tried before.

It is indeed a most egregious error to assume that the division of contracted muscles is merely of mechanical importance; in some as yet physiologically unexplained manner do the contracted muscles relate to the existing joint disease. The retractions never appear before the disease has advanced to a certain degree of violence and structural invasion; and, unless overcome in an effective manner, they increase to actual contracture. In all these cases the disease is necessarily protracted; and when at last it subsides the contracture remains, though its original cause has disappeared. On the other hand, the original joint disease may be reproduced after years of extinction, if the contracted muscles are unduly and persistently extended. Some cases of this description are but too lively in my remembrance, and my experience on this subject is too dearly bought to be ever forgotten.

From all this it follows that certain muscular groups stand in vital relation with certain joints, one actuating and irritating the other through the same source of nervous supply. Hence the division of so contracted muscles has a vital bearing on the status of the joint, aside from the mechanical relation. In this view we have to judge the therapeutical character of the operation. Dieffenbach already suggested the *antispastic effect* of myotomy and tenotomy; I not only accept his view as correct, but from experience I am justified in enhancing the same, that in joint diseases at least it is the most reliable, prompt, and unfailing antiphlogistic.

Having suggested and practised myotomy as an antiphlogistic, it is but natural that I should spread before you the ground on which it stands. The way in which I came to the knowledge and appreciation of this remedy was simply this: Acting on the conviction that rest and position were the two great axioms in the treatment of joint diseases, I had to dispose of

muscular resistance as best I could; and often not being able to get rid of it by any other means, I resorted to division. The effects of the division upon the arrest of the joint disease being strikingly beneficial, I gradually included the same as a remedial agent. A practice of fifteen years' duration of this operation entitles me to a vote on its merits.

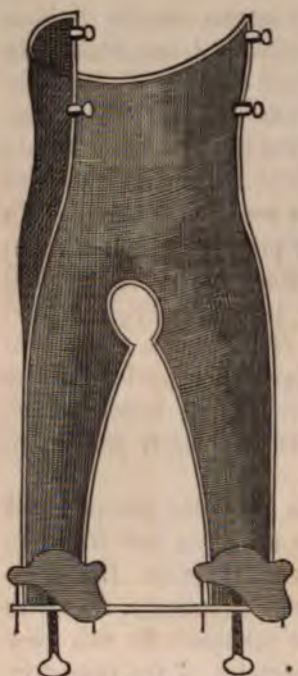

FIG. 56.

More than in the first stage, rest and position of the affected joint are requisite in the second, and it is in this where special apparatus are profitably resorted to, to accomplish so important an object. In hip disease, my wire apparatus has not yet been exceeded by any later invention. I place it before you for inspection (Fig. 56). You will see that it consists of a heavy wire frame, which is so covered with wire webbing as to fit the posterior half of the body, from the axillary cavity to the sole of the foot. There is an opening for the anus; the foot-boards move by a screw and bolts. To protect it against the corroding influence of urine and fæces, that part of the apparatus most exposed should be thickly covered with varnish. The average price of the same for children is fifteen dollars currency. In using the apparatus (Fig. 57) you have to line it with cotton or other wool or tow, and whilst the patient is under chloroform you place him in it, and fasten, by means of flannel bandages, body and limbs so securely as to insure his position. If you should desire likewise to apply extension, for greater security of rest and position, you may apply longitudinal and circular strips of stout adhesive plaster, and fasten the former to the foot-board.

Some writers, among them Mr. Barwell, have challenged the originality of this invention, and boldly pronounced it a copy of Bonnet's wire apparatus. I apprehend that Mr. Barwell has

seen neither, otherwise he could not have come to so inapplicable a conclusion. I have never claimed the introduction of wire into surgery; that point is conceded. Bonnet's apparatus is a clumsy and unwieldy contrivance, produced for no other purpose than to raise the patient, by means of pulleys, in such a manner as to obviate painful jarring; my apparatus is an improved Dzondi-Hagedorn, where direct extension can be exercised, whilst the counter-extension rests with the healthy extremity, on the same principle which we employ in having our boot pulled off.

Fig. 57.

I leave it for you to decide whether the mode of extension commonly employed in hip disease offers the same advantages as my apparatus.

In this, position and rest are insured; the patient can pass his fæces with perfect ease, by raising the lower end of the apparatus and placing a bedpan under it. You can carry the patient from one place to another, put him in a carriage, draw or drive him into the open air, and thus meet all the objections that have been raised to confinement.

In the other mode, the extension is a fixture of the bed; but, what is still worse, it allows the patient to accommodate himself

to the position, so as to render extension nugatory. I have seen the patient turn right around, with the perineal band, and accommodate himself so ingeniously that the malposition became as bad as if there had been no restraint whatever.

Davis, Vedder, and Barwell have successively suggested *portative extension apparatus* to obviate the confinement of the patient. The honor of the original suggestion is entirely due to Davis, and the merits of the same ought to be liberally accorded to him, for it certainly has broken the ice of the scrofulous heresy, and paved the way to the rational ideas of therapeutics which *had been previously advanced*, but disregarded up to that time. Sayre, though strictly speaking but an exponent of Davis, nevertheless deserves some credit for the adroitness with which he has propagated and popularized the instrument, which seemed to have been an elephant in the hands of the inventor.

FIG. 58.

Davis' instrument, as improved by Sayre, is here shown (Fig. 58). But all the before-named apparatus are at fault in one essential point; they neither fix the affected joint, nor do they prevent the adduction of the extremity. The amount of extension exercised by them is, moreover, very insignificant, and if it was fifty times as much it could not separate the articular surfaces of the hip-joint, as is erroneously claimed by their respective authors. Besides, they depend on adhesive strips for their fastenings, which do not stick well in cold weather, and easily slip in warm. Sayre's modification, to circumvent the affected extremity with a semicircular addition at the lower end of the instrument, so as to gain two purchases and two fastenings, was an acceptable improvement in the adjustment, but no more.*

These deficiencies in the mechanical construction of portative apparatus have obviously induced Andrews, of Chicago, to fasten a straight steel crutch to the boot, allowing shortening and

* The latest contrivance of this kind is that of Dr. Taylor of New York. He needed not to have gone to the expense of a patent (!), because it offers no superior inducements, and is not likely to be employed by any one else.

elongation. In appropriating thus the foot for extension, the tuber ischii for counter-extension, and the screw as the moving power, he happily supplied a desideratum, and got rid of the annoyance and insufficiency of the adhesive strips.

FIG. 59.

I had seen nothing of Andrews' very acceptable improvement when I constructed the apparatus which are now before you (Figs. 59 and 60). From this to that which I now use was but one step (Figs. 61 and 62). It needs no description or explanation; its construction speaks for itself. Not knowing the chronological priority of either Andrews' or my appliance, I will concede with pleasure this honor, if such it be, to my diligent colaborer on this field of surgical culture.

My instrument affords both efficient extension in a vertical line, and complete fixture to the joint, wherein lies its chief usefulness. For two years I have had it in use, and it has given me the fullest satisfaction, in promptly responding to all the indications that can possibly be realized by such a contrivance; and, above all, it has guarded against the reshortening of the adductor muscles, once divided, which so often happened in my practice when I used Davis', Sayre's, and Vedder's apparatus.

That of Barwell I know but from its illustration; I have never seen nor used it, and forego an opinion on its merits.

With all advantages that may possibly accrue from my instrument, I must warn against its premature use at the second stage, unless the disease has substantially subsided, and you intend only to follow up the results of your treatment by its application; the superincumbent weight is too much for an inflamed hip-joint, even when supported.

To secure the rest and position of the knee-joint, I generally prefer metallic splints to stiff bandages. You can handle them better without jarring the joint; you can leave a part, or the entire joint, free for observation and local appliances, and lose

nothing in the mechanical effect; you can take them off and re-apply them with the greatest ease; you can combine extension with them, give it inclined plane, etc., and thus secure all the advantages for your patient that could be desired. I generally keep a set of these splints on hand, so as to be prepared for emergencies. The price is but trifling.

FIG. 60.

One is a simple gutter-splint (Fig. 63) for simple cases. The other has a semicircular deficiency at the knee-joint, to expose one or the other side (Fig. 64). The third consists of two splints joined by intermediate iron braces, designed to leave the knee-joint entirely free (Fig. 65).

By drawing bandages from one side to the other across the knee, a moderate degree of anterior pressure may be exercised. If the patient has so far recovered as to resume locomotion with safety, a portative apparatus of an approximate efficacy should be substituted for the metallic splint. For this purpose stiff bandages, leather, or gutta-percha splints, or a special contrivance (Figs. 66 & 67) would equally answer. The last consists of two braces along the limb, three or four bands, with a knee-cap made of buckskin. If the patient's limb is much attenuated and cylindriform, it would be an improvement to connect the apparatus with the boot, so as to prevent slipping.*

Sayre has introduced, for the purpose just mentioned, a portative extension apparatus for both knee and ankle joints, with a view of parting the affected articular surfaces, and thus alleviate pressure upon one another. My belief is that such an object is

* The extension in Fig. 61 is effected by a well-fitting laced boot, and the counter-extension by the crutch placed against the tuber ischii.

unattainable by any mechanical contrivance, and moreover superfluous.

In placing an affected joint in such a position as to have the largest possible contact of the articular surfaces, we at any rate diffuse the pressure, if it actually does exist. Sayre's knee apparatus can only be used when the limb is fully extended.

FIG. 61.

FIG. 62.

In order to perform paracentesis of an articular cavity, the rule ought to be observed, to place the joint in such a position as to drive the liquid to the most accessible spot. At the hip-joint this is at the posterior circumference of the acetabulum. The glutei muscles being attenuated, we generally succeed in discovering fluctuation at that particular place. Whilst the surgeon is about inserting the trochar, an assistant takes hold of the affected extremity and rotates it inwards, which gives the greatest distention to the posterior wall of the capsule. This manœuvre not only facilitates the entrance of the instrument, but likewise the exit of fluid, and prevents the entrance of air.

At the knee-joint we have to procure first a straight position, which drives the entire liquid into the anterior portion of the joint. By means of a tightly-applied flannel bandage, commencing at the toes, we obviate œdema; the joint is then surrounded with stout adhesive straps, from the tuberosity of the tibia to beyond the patella; the unevenness of the joint being previously filled with graduated compresses or with cotton. Thus the liquid is driven to the cul-de-sac, where it is easy of access. That place in the cul-de-sac between the duplicature of the vagina femoris and the tendon of the biceps is most available,

FIG. 63.

there being no muscular structure interposed. Having thus well prepared the articulation, you will easily enter with the instrument, and the liquid will rush out through the canula with great velocity; by moving the finger across the distended portion you still more facilitate its exit, and with the same finger close the wound, while the other hand withdraws the canula.

I have thus in numerous instances entered the articular cavity, and repeatedly the same articulation, without having caused in a single instance reactive trouble. I scarcely ever failed to give instantaneous relief to the joints, although in many cases but temporarily.

FIG. 64.

This is the same procedure which I invariably adopt in the treatment of hydrarthrosis, and which has proved in my practice a very reliable method.

Puncture of the joint, in these cases, has been unjustly abandoned by the best surgical authorities (among others Nélaton), who consider it dangerous, inasmuch as there is not sufficient centrifugal pressure of the liquid to prevent the entrance of air;

Fig. 65.

for he states most emphatically that the interarticular fluid runs out slowly, and never entirely. By the plan just advanced we overcome all difficulties and dangers; thus one of the objections may be considered disposed of. The other concerns its efficiency; in this respect I can but state that, with the exception of one single case, I have radically relieved twenty-seven cases; one by three, two by two, and the balance by one puncture. Of course I have continued compression of the articulation for some weeks after the operation. All the cases operated on were protracted ones of not less than three months', and the majority of more than a year's standing.

This plan, then, compares very favorably in point of dispatch and efficacy with any other I know of, and certainly is not as hazardous as the injections suggested and practised by Bonnet and Nélaton.

Compression of affected joints is one of the most estimable auxiliaries in their treatment, and should be resorted to wherever it is practicable; but when resorted to it should be thorough and decided. Whether the substance employed for compression has any additional virtue, and whether therefore porous or impermeable substances should be used, I am not as yet decided; my experience is almost entirely confined to the use of adhesive plaster spread on Canton flannel, on account of its pliability and durability; and I have been satisfied with the usefulness of these substances.

When, in spite of this treatment, the disease should advance, the articular cavities become more and more distended, and the

tendency to disruption is manifest, then the question of free incision arises.

Gentlemen, I am most anxious to put my views on this question so definitely on record as to leave no doubt as to their bearing and meaning; therefore I wish to be understood: *First.* That I do not advise nor practise any meddlesomeness with joints at all, unless the strongest indications prevail. *Second.* A moderate quantity of liquid within the articular cavity, whether

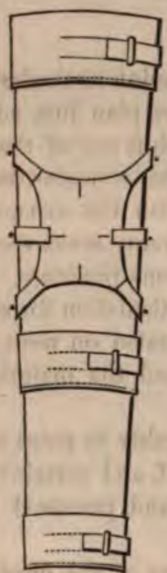

FIG. 66.

FIG. 67.

this liquid be essentially synovia or plastic or purulent effusion, is no indication *per se* to puncture a joint, for the two former liquids may readily be absorbed and got rid of, and so may pus, by previously undergoing a fatty degeneration. I have met with such cases; and but lately the joint of one of my patients opened in the middle of the thigh, from which I could squeeze a large quantity of pus, fragments of cartilage, and other detritus which had for months painlessly occupied the joint, and had completely undergone fatty degeneration. *Thirdly.* I puncture

the articular cavity if the effusion is progressive, the distention of the joint very painful, and for the purpose of reducing an existing malposition, provided the latter depends in part or *in toto* on the presence of intra-articular effusion. *Fourthly.* I open affected joints by free incisions, when progressive suppuration of the internal articular surface exists, and threatens disruption of the capsular apparatus.

If I am not mistaken, my esteemed friend, John Gay, Esq., of the Great Northern Free Hospital of London, has first claimed the legitimacy of this operation, and received a goodly share of abuse for it. I have to offer but a few remarks on the usefulness of free incisions. The very essence of surgical wisdom is to imitate nature, and to avail ourselves of similar means for certain purposes. In suppuration the joint is first distended to its utmost capacity by pus, and then spontaneously opened, and the matter forced into the adjacent tissues. The ordinary place of perforations is near the bone, sometimes in part below the periosteum, mostly under the respective fasciæ of the extremities, into the interstices of the muscles, and along the bone; additional destruction is thus caused.

If a joint disease has acquired this character, the joint, as such, ceases to exist; all the structures constituting the internal surface undergo pathological changes, which mostly admit of no reconstruction; the articular cavity is simply an abscess, and should be treated as such. The old surgical axiom, "ubi pus ibi evacua," has received its qualification by modern surgery, but its full sway must be recognized whenever the abscess manifests its tendency to spontaneous opening. For if we have to choose between the alternative of spontaneous perforation, and its undesirable sequelæ, and free incisions, no surgeon can hesitate in his preference. Sometimes it might be advisable to puncture the joint, and even repeatedly, with a view of obviating the danger of spontaneous disruption; but if the latter presents itself in unmistakable signs, we should not hesitate in changing the articular cavity into an open abscess, and give free vent to its contents. Hancock, of London, claims exsection of the joint as preferable to free incisions, being more efficacious and less dangerous. There is some conditional truth in this proposition, well deserving consideration. If you freely open a joint

and find pathological changes beyond those of simple suppuration, as for instance extensive caries, the sequestration of a bone, the partial or total destruction of intra-articular ligaments and cartilages, in fact changes that would require many months to overcome, exsection of the joint would be infinitely preferable; in such case, the free incision would be the initiatory step toward it. On the other hand, if the joint is in a condition of simple suppuration, so that the closing up of the articular cavity by granulation might be safely relied on, the free incision will suffice. In fact, both are distinctly different remedies for distinctly different purposes, and one cannot be substituted for the other.

Having laid down the general principles for the second stage of joint diseases, we may now refer to a few special points. One of them is the treatment of subperiosteal extravasation or effusion; another, the special treatment of those necrobiotic disintegrations of one or the other condyle, to which I have adverted in another part of our discourse. The management of the former is very plain: a subcutaneous division may give all the needful relief, and stop the impending trouble, at any rate prevent its increase. The other is of a more subtile character, requiring a clearly established diagnosis, settled therapeutical principles, and consistent action. How to arrive at the first I have already indicated; and to render the diagnosis still more conclusive, the use of an explorative trochar would be advisable. If we have become thus satisfied of the nature of the complaint, trephining by a small instrument, and the subsequent scooping out of the disintegrated tissue, is the most direct and legitimate remedy. I must, however, confess that I have but in few cases resorted to this operative procedure, though with marked success; my personal experience is therefore limited, but it would seem the most appropriate and direct remedy when a clear diagnosis can be obtained.

In summing up the treatment of the second stage of joint diseases, you will perceive that I rely exclusively on local appliances with a view of obtaining *First*, *rest*, and *position* of the affected articulation. In procuring these I have occasionally to divide resisting muscles and to puncture joints.

Second. Compression of the inflamed structures.

Third. Paracentesis and free incisions in joints when suppuration prevails.

Fourth. In dividing periosteum, and in removing disintegrated bony structure by trephine and scoop.*

In the second stage of this class of disease we have often to deal with violent constitutional disturbances, which are more readily overcome by proper local treatment than by any other devised medication; nevertheless the utmost attention should be given to proper diet and hygiene, which is the more necessary as all these cases are more or less protracted, and therefore more or less bear upon the constitutional vigor.

Now, gentlemen, let us contrast the treatment just described with the measures of the old school. Ours is mild when compared with the barbarous derivatory appliances. Moreover, ours is effective; the other is worthless. By our treatment the joint is placed in a condition of spontaneous recovery. The other proposes to subjugate, by direct means, a disease over which it never had nor could exercise any positive influence. Nor is this all; by applying the actual or potential cautery, new troubles are superadded and new taxation is imposed upon an already overtaxed constitution.

But derivation is not only barbarous, useless, and obnoxious, it is even inconsistent with the very pretensions for which it is used. Supposing tubercular depositions are at the bottom of a joint disease, these depositions are either latent and innocuous, or they act like any other foreign substance in creating circumferential inflammation with a view of eventual elimination. In the former proposition we know nothing whatever of the presence of those depositions, simply because they give no trouble. If we could possibly anticipate the time when such tubercular depositions would be likely to take place, then derivation might be relied upon as a preventive of the impending danger.

But since we have quietly to wait until the so-called tubercular depositions are formed, and until they are undergoing the process of softening and compromising the surrounding structures, there is not even a pretence of reason to employ derivation, just as little as if any other foreign substance was lodged within the precinct of the organism. It is claimed that tubercle is not

* Kirkpatrick, *Medical Press and Circular*, Dublin, Aug. 21st, 1867, recommends the use of escharotics, especially potassa c. calce, for the same therapeutic object, and relates most beneficial results.

only without organization, but not even susceptible of it. Derivation can therefore exercise no action upon the tubercle itself; that much must be logically admitted. Can it prevent the disintegration of the adjacent structures, and reëstablish their former type? Of course not; then what is to be expected from derivation at all?

The progress of pathology has been most fruitful in recognizing the existing physiological laws which govern alike health and disease. The most reliable observers tell us that inflammations, once set up, will run their course to their termination, whether medication be imposed or not. The idea of bringing a recent pneumonia, bronchitis, pleuritis, or a catarrh of the air-passages to an abortive end has been so thoroughly exploded that no wise practitioner follows any other than the expectant method of treatment; and Hughes Bennett has earned for himself a lasting distinction in proving that fact by clinical statistics. If you concede the fact, you have to accept the inferences; that is to say, if you cannot cut off or shorten the course of a recent disease by any means, what can you hope to do in cases of long standing, in structural disintegrations, and more particularly then when the cause (tuberculosis) is persistently at work?

It will be equally easy to demonstrate the utter uselessness of derivation in the primary affections of the synovial lining. In the mildest form of them (hydrarthrosis) there is a degeneration of the synovial membrane, which Johannes Muller describes as lipoma arborescens, which is fully compatible with the increase of the natural secretion, but in which, however, the absorbent powers seem to be entirely lost. Next, you have the so-called catarrh of the synovial lining, in which, according to Volkman, the epithelium is partly thrown off, partly converted into pyogenic source; there you have morbid secretion and loss of absorption. And if you have to deal with a more parenchymatous suppuration of the membrane you have no longer synovial membrane, but a luxuriantly granulating and secreting surface, with very doubtful absorbing endowments.

The *restitutio ad integrum* is absolutely conditional to the reëstablishment of absorption, and this is a question of time. Can you reach or overcome such a difficulty by blistering, or any other derivant applied to the external surface of a joint?

Certainly not; as in pleuritic or pericarditic effusions, you have either to tap or patiently wait.

I do not want to enter more deeply into the discussion of the therapeutic value of derivation, heretofore unduly praised and over-estimated. All I propose is to make a few hints and suggestions, and leave the rest to your mature deliberations.

In the third stage of joint diseases we have still more to deal with both extensive and continued changes, in which mostly all the component parts of the articulation are compromised. In whatever tissue the malady might have started, in its progress it has comprised the rest. Thus, in synovitis the articular cartilages have been exposed to constant maceration of pus, and have suffered those elementary metamorphoses to which I invited your attention on a prior occasion. And when at last they drop off in rags and fragments, the osseous surfaces of the epiphyses are in turn subjected to the same obnoxious actions.

With the progress of their disintegration the periarticular structures become more or less invaded, and gradually manifest conditions very similar to those of white swelling. If, on the other hand, the primary affections of the periosteum and epiphysis proceed to the perforation of the articular cavity, it is self-evident that its lining must suffer appropriate alterations. The third stage is consequently a disease of the entire articulation, and its treatment a formidable object of the healing art.

Notwithstanding the undeniable difficulties of these affections, quite a large proportion of the patients recover with or without aid, and sometimes under domestic surroundings of the humblest kind; whereas others run their course to destruction in spite of therapeutic efforts and hygienic advantages. The reason of this difference is not always apparent. Occasionally the abscess determines where the joint gives way to the centrifugal action of the pus. If, for instance, the pus escapes through the floor of the acetabulum, it spreads over the internal surface of the pelvic bones by detaching the periosteum, and may eventually make its appearance below Poupart's ligament, or through the ischiatic notch, or between the gluteal muscles. Irrespective to the lesion of the hip-joint itself, this condition alone would constitute a frightful disease, sure to terminate disastrously. Similar com-

plications may occur with other joints, and aggravate their respective diseases.

The indications of treatment diversify with the complications presenting. Generally speaking, the same therapeutic rules come into play at this juncture which have been already detailed. *Rest* and *position* exercise, even in these aggravated cases of joint disease, their beneficial influence; but the appliances should be portative, so as to allow the patient the conditional enjoyment of open-air perambulations. Of these the patient is greatly in need to sustain his constitutional standard. The appliances should moreover be such as would not be easily saturated and soiled by the discharges. James Startin's suggestion to impregnate the bandages and splints of felt with an equal mixture of melted paraffine and stearine, for the double purpose of stiffening and rendering them water-tight, is certainly deserving of attention.

I have not as yet employed this material, but it seems to me preferable to varnish coating, heretofore used.

It is self-evident that the fixture of the joint is an essential desideratum to prevent the corroded surfaces of the epiphyses from grinding upon one another, and thereby give rise to pain and renewed irritation.

The fistulous openings should be maintained, and their drainage kept free. This is, however, no easy task, because their sinuses are very circuitous, and dilatation by laminaria or compressed sponge impracticable. The laying open of the tracts by the knife is mostly of but temporary assistance, incurring loss of blood which patients can scarcely bear. The employment of potassa c. calce (Kirkpatrick), to open direct communication between the articular cavity and the surface, deserves surgical consideration.

Abscesses frequently form in the circumference of joints. Those which are attended with great swelling, pain, and fever, and indicate the efforts of nature to eliminate structural detritus, should be promptly and fully opened; those which appear more or less remote from the articulation, and cause no local or general inconvenience (cold and consecutive abscess: abscessus congestionis), may be ignored as long as they do not raise alarm by their size and pressure upon important parts. Their contents readily undergo fatty degeneration, followed by gradual resorp-

tion. But if they require opening it should be done by trochar, with the exclusion of air. The knife should only then be employed when the air has entered the pyogenic cavity, and decomposed its contents. In this way septicæmia with its fatal consequences can be averted.

With a view of bringing about a more decided detachment and diminution of the structural detritus, various means have been recommended. John Gay insists upon free incisions into the affected joint; others allege they have successfully employed the seton, and Kirkpatrick favors an opening with his escharotic into the joint, and uses it freely upon the osteoporotic substance, and finally exsection. The two former apply only to superficial and accessible joints, and all four are necessarily followed by copious suppuration. They are therefore but available in well-preserved constitutions, and in superficial caries of the articular faces.

It is obvious that no debilitated patient can pass unharmed through so consuming an ordeal. As to exsection, I beg to submit:

1. That if a thick slice is removed from the epiphyses, we approximate the cartilaginous disks fastening them to the shaft, which may thus become involved, protract and even prevent the reunion.

2. That if we compromise the cartilaginous disks in the operation, the extremities become so much shortened as to render the result nugatory, and the artificial leg preferable.

3. That the exsection of single tarsal and carpal bones is but very exceptionally attended with good results, on account of the existing intercommunication of the tarsal and carpal joints.

The arrest in the growth of extremities operated upon by exsection, as observed by Kœnig, of Hanau,* is probably founded on error, and should not prevent us from resorting to so legitimate an operation in its proper place. The growth is impeded by the previous disease, a fact most probably ignored by that author.

From these remarks it appears that exsection, as well as amputation, has its defined therapeutic value, and one cannot well be

* Archive of Clinical Surgery, Berlin, 1867.

substituted for the other without risk and injury to the patient. I have nothing to do with the technicalities of either operation at this juncture.

Permit me, however, to tender my advice in reference to two points in exsection:

1. Before proceeding with the operation, overcome if possible the existing malposition by dividing the contracted muscles. I have mostly taken these preparatory steps, and thereby secured perfect control of the subsequent position of the extremity. I owe, perhaps, to the observance of this preliminary measure the happy results that have attended my operations, more particularly at the knee-joint. Whereas some of my surgical friends who neglected it had great trouble to maintain position, and lost their patients. The supposition that the shortening of the limb is sufficient to relax the contracted muscles, proved, in their respective cases, to be erroneous.

2. I remove with great care and accuracy as much of the synovial membrane, serous slides, and bursæ (Bilroth) as are extant and exposed to air, for they will suppurate and materially retard union.

At this juncture the debilitated state of the constitution deserves the closest attention. No medication will, however, be of service as long as the local troubles are not mitigated by a proper course of local treatment.

The amelioration of the articular disease is the most direct way of relieving constitutional reaction. Nevertheless, quinine, iron, cod-liver oil, and sedatives may be needed to control fever, promote hæmatosis, supply an easily digested nutriment, and secure repose and immunity from pain.

In *morbus coxarius* the principles of division of the morbid periods rest on a different foundation; and accordingly the third stage of that disease is determined by the spontaneous disruption of the articulation, and a peculiar malposition of the affected member.

It is of course necessary to ascertain the anatomical and clinical character of the existing malady, to determine the plan for therapeutic action.

If the inflammatory character of the disease still prevails, the appropriate means will readily suggest themselves from preced-

ing remarks; and as readily if caries has ensued. The contracted muscles require division to allow the reduction of the existing malposition. Next, the articulation should be kept at rest by means and appliances with which we have already become acquainted, irrespective of the prevailing state of the joint; being equally beneficial in arresting articular inflammation as preventive to the irritative grating of carious surfaces upon one another.

If anchylosis should thus ensue, it will take place in the most desirable and useful position of the extremity.

Locomotion of the patient renders the use of crutches indispensable; the weight of the body will aggravate the local trouble. Only when the caput femoris shows disposition to slide up and backward does extension become imperative. My portative apparatus answers the indications.

When, however, no improvements in the pathological condition of the joint follow this treatment, when caries and suppuration continue and threaten the patient with hectic, then the exsection of the head of the femur is justifiable and appropriate.

Fortunately, the rational and successful treatment of morbus coxarius lessens the exigency of that operation, and to this fact we may ascribe the present rarity of its performance.

Notwithstanding the avowed aversion of French surgeons to this operation, it cannot be denied that it has furnished a fair statistic of success, and that it has saved the life of many a patient which otherwise would have been lost.

Of the seventeen partial exsections of the hip-joint which I have performed in the course of my surgical career, nine were attended by recovery and two are still under treatment.

The limbs have been shortened from one to three inches.

With the exception of one case, the sclerotic tissue formed between the acetabulum and the shaft of the femur permitted a moderate mobility, and is strong enough to bear the superincumbent weight of the body.

That case concerns a young lady upon whom I operated in the year 1856, when she was nine years of age. Owing to monstrous obesity, the intermediate substance has never become firm. I have seen this patient but lately; she has grown to be a handsome and healthy woman, and I have again had an opportunity

of examining into her condition. When she stands on her right limb, the mere weight of her left suffices to bring it to its full length. But if she rests upon the latter, the intermediate substance bends outward and allows the shaft of the femur to come in contact with the acetabulum, by which the limb is three inches shortened. In this position she can bear the entire weight of the body upon the affected side. My apparatus gives her the desired support for locomotion, and with it her gait is easy and graceful.

I apprehend that some of the exsections which I have performed have been under rather unfavorable circumstances, and yet withal the conjoint result is anything but discouraging; some of my patients died of other diseases (two of laryngeal diphtheria, and one of cerebral meningitis) evidently connected with the impoverished state of their respective nutrition.

Though I am not a great admirer of exsection of the hip-joint, nevertheless I honestly believe that its performance, when warranted by the anatomical changes of the joint, bids as fair a chance of success as the exsection of any other joint. It is scarcely necessary to remove carious portions of the acetabulum unless very accessible, for the nutrition of that portion of the pelvis is unimpaired; and inasmuch as it remains accessible to local appliances, it becomes soon repaired.

In those patients who died after the operation, I invariably found the acetabulum restored to its integrity.

CHAPTER XVII.

TREATMENT OF THE SEQUELÆ OF JOINT DISEASES.

Stiffness and its treatment.—Malposition and anchylosis.—Gradual extension.—Tenotomy.—Brisement forcé.—Louvrier.—Dieffenbach.—Langenbeck.—Accidents.—Rhea Barton's operation.—Brainard's plan.—Deformities of hip and knee-joint.—Their treatment.—Cases.

THE most judicious and diligent treatment succeeds but rarely in restoring the affected articulations to a perfectly normal status. There remains generally some tenderness of the articulation, which shows itself after a liberal use, and on changes of the weather. Besides, a certain stiffness and dryness may continue a long time after the disease has become completely extinct.

The treatment of this symptom may be fulfilled with aromatic lubrications, cold and warm douche, flannel bandaging, the longer use of "sole baths," which in Germany have acquired great reputation in these troubles. More than all, *passive* and *active exercises* are best calculated to give permanent relief. Even slight malpositions may be gradually overcome in this way. There are quacks in every country who acquire reputation and lucre from the treatment of these articular impediments, and surgeons may learn from them the undeniable benefit of the use of apparently so insignificant remedies as lubricating frictions and passive exercises. I have myself to acknowledge some practical information from this rather turbid source. Having straightened the contracted knee of a lady patient, and repeatedly moved the same under chloroform without succeeding, I at last gave it up. After some months I again met her, with a perfectly flexible and useful joint, and learned that a female quack had restored her extremity to usefulness by persistent and daily lubrications and passive motions. In the beginning, the treatment had been very painful and almost unendurable; but gradually the pain had subsided. I need not assure you, gentlemen, that this lesson was not forgotten by me; and I am anxious to

impart its benefit to you. If you have no time yourself, I would advise you to employ menial hands; but do not give quackery a pretence to superior skill and practical efficiency.

The passive motions are best commenced with the assistance of chloroform, which will enable us to overcome impediments without any hazard whatever to the patient. Tenderness of the joint may follow, but will subside with a day or two of rest. The passive motions should then be renewed, with or without chloroform, as the case demands, and should be carried on until the desired results are achieved. The patient may greatly assist our efforts by appropriate movements.

If, however, the previous treatment has been inefficient and regardless of consequences, the patient will present more aggravated conditions. The very best treatment is no sure protection against *an obliteration of the articular cavity; but malposition of the joint may, and should, always be prevented.*

Anchylosis forms, then, another object of after-treatment. Surgery discriminates two forms—the false or fibrous, and the true or bony; to which might be added a third, by bony bands or osteophytes. The first consists of partial or total connection of the articular faces by sclerotic tissue; the second in the bony interposition; and the third forms a partial osseous involucrum of the joint. The false anchylosis results from synovitis, both primary and consecutive; the true from penetrating wounds and caries of the articular faces; and the last from suppurative periostitis.

There is always more or less mobility in false anchylosis, but there is no vestige when osseous material forms the connecting link. When muscular contractions existed previous to the agglutination of the articular faces, the mutual anatomical relations of the latter are invariably changed.

The treatment of anchylosis has always been a cherished object of surgery, from Hippocrates down to the present time. Success is, however, but of recent date.

Gradual extension for the purpose of overcoming fibrous anchylosis is an old surgical proceeding, and has from time to time found advocates in the professional ranks. Mechanical ingenuity has found a fruitful field for display in the construction of all sorts of instruments; the latest method introduced is that by pulley and weight.

The usefulness of gradual extension in the treatment of fibrous anchylosis is for obvious reasons but *limited* and *conditional*, and the attempt to substitute the same for *brisement forcé* is a failure.

The anatomical conditions resulting from joint disease are but exceptionally amenable to that method; it is tedious at best, and frequently so *painful* as not to be borne by many patients. Its claimed superiority is, moreover, anything but conclusive. Nevertheless we meet with cases in which the elastic resistance of intra-articular adhesions and of the capsular ligament can be but overcome by gradual and persistent extension, and in these it seems to be the only remedy. These conditions we recognize only after unsuccessful attempts at *brisement forcé*, and the latter has therefore to precede.

Such cases may be rare, and constitute but a small fraction in statistics; but they do exist, notwithstanding their denial.

I possess two specimens of this very character in my collection, both derived by amputation of the thigh. One belongs to a lady who had contracted fibrous anchylosis of the knee from rheumatic synovitis, aggravated by contraction of the hamstring muscles. Before coming under my charge she had suffered *brisement forcé*, without previous division of the contracted flexor muscles. Violent reactive inflammation of the joint followed the forcible extension, and the latter was too painful to be maintained. The integuments sloughed at the internal circumference of the articulation, and her constitution was so violently shaken that her recovery was placed in jeopardy; and when, after many months of severe suffering, she had regained her strength, she was to all intents and purposes in a *worse condition* than before the operation. Moreover, the leg was in so high-graded a state of hyperæsthesia that she could not bear the slightest touch, and the thickened epidermis was peeling off in large patches. Although desirous of amputation, I deemed it my duty to try once more *brisement forcé*. Assuming that the omission of myotomy was the cause of the disastrous failure in the first instance, I divided the contracted hamstring muscles previous to the operation. I met no difficulty in breaking down the intra-articular impediments, but I exerted my entire physical strength in vain in attempting to fully extend the leg. I succeeded, perhaps, to an angle of ° but could not keep the leg in the same. It

would jerk back in an instant as soon as I relinquished my efforts.

Applying in the usual manner longitudinal adhesive straps, and fastening to the same a weight of fifteen pounds, I tried gradual extension over a pulley. No reaction ensued. The limb yielded but very sparingly to extension, and the improvement during the following fortnight was just noticeable. A second effort was then made, terminating as before. I was certain that the muscles had no part in the resistance, having been thoroughly divided. The patient lost all confidence in her eventual relief, and insisted on amputation, which I dared not refuse; for, irrespective to the deformity, the hyperæsthesia alone rendered her condition insufferable. The examination of the specimen revealed the fact that the resistance was exclusively due to the posterior wall of the capsular ligament, which was greatly thickened and pervaded with copious elastic fibres. Even after I had cleared it of tendons, lateral and crucial ligaments, it was impossible to straighten the joint.

The other specimen refers to a little girl eight years of age, who had two years previously acquired an affection of the knee-joint through traumatic injury. When I took charge of the case I found her knee-joint in an angular position, and its mobility greatly impeded by intra-articular adhesions. There were some fistulous openings at the internal circumference of the articulation, at the bottom of which bare bone could be felt, to a limited extent.

In attempting to perform *brisement forcé*, the resistance of the adhesions was very great; and though I proceeded with great care and precaution, I had the misfortune to produce diastasis of the femoral epiphysis. The limb was again placed in its original malposition and kept at rest, and well sustained by plaster-of-Paris bandages. No trouble at all followed the unsuccessful attempt, and the epiphysis was in due time found firmly united to its shaft. Though I did not feel inclined to hazard another trial of the same kind, I was prevailed upon by the uncle of the patient, who is himself an esteemed physician, and by the family at large. You may well suppose that I was very timorous in the second attempt, and that I used no undue force. In fact the extension of the limb was effected by straight traction,

and without using the respective bones as levers. On this occasion I succeeded in opening the angle considerably, without being able to straighten the limb completely. But, as in the former case, there was an elastic resistance to contend with, which reduced the angle at once as soon as the tractions were slackened. Moreover, the extension of the limb was accomplished at the expense of a shifting of the tibia backward on the femur, and a slight bending of the tibia and femur. There was no separation of the articular faces. Although I had again divided the hamstring muscles, and again allowed the limb to resume its old malposition, nevertheless the ensuing reaction was quite formidable. The patient, being of a very delicate and nervous constitution, could not have endured without succumbing to the violence of the symptoms, and therefore amputation was resorted to to avert the fatal catastrophe. Happily, recovery ensued without any untoward occurrence.

In this specimen the resistance was due to the strength and elasticity of the intra-articular fibrous adhesions, and I was unable to overcome it by any means short of entire demolition of the specimen. In attempting to straighten the same, the epiphyses of both constituent bones were proportionately compressed, and the shafts bent, whilst the anatomical relations of the joint remained unchanged.

It is very evident that from these and similar causes the extension per force is not always practicable; and there remains, consequently, a limited orthopædic field for the employment of gradual extension.

When in London, I saw a young woman at the Royal Orthopædic Hospital who had been successfully relieved by gradual extension from a fearful distortion, caused by a very thick and apparently unyielding cicatrix, the result of an extensive burn. Her chin had been literally drawn down and fixed to the chest. She was then still under treatment, but her head stood already erect, and most of its motions were free; the cicatrix was soft and pliable. This startling result had been achieved by persistent gradual extension throughout three successive years.

The anatomical composition of scar tissue is the same which characterizes the fibrous impediments of my cases; and if the ner can yield to persistent extension, the latter likewise will.

In preferring this method in any given case, I should advise to remove all and every muscular resistance by previous division. There are some authors, among whom Barwell occupies a prominent position, who oppose, for several reasons, this operation as unnecessary and objectionable. According to their reasoning, the contracted muscles are in a state of clonic spasm, which will yield to persistent extension.

I have already exposed the fallacy of this opinion in another place, and proved by theory and practice the inefficiency of gradual extension in as far as muscular contraction is concerned. But if it is impossible to extend them in more recent cases of joint disease, it is surely impracticable in protracted cases, and after the muscular tissue has been displaced by structural elements devoid of expansibility.

From my experience, gradual extension is absolutely dangerous, being apt to produce fearful and insufferable pain, and reproduce the original disease of the joint.

I am indeed astonished at the self-assurance with which Mr. Barwell claims invariable success. The field of his clinical observation must indeed have been very limited when he never met with cases in which gradual extension gave rise to serious troubles. All his arguments against the division of contracted muscles are, moreover, of a very insignificant nature. Mr. Barwell says the divided tendons of muscles do not readily unite. I deny this assertion, as entirely unfounded; if the division is carefully performed, and the theca of the tendon respected, it will unite readily, and form firm and reliable connection. My experience has been rather the other way, and therefore I have been occasionally compelled to redivide the same structures.

Next, it is asserted that the divided muscle is so much shortened by the operation as to lose entirely its physiological office. However, how can the muscle lose a function which it does not possess? The division of muscles which had not entirely lost their physiological expansibility does not permanently destroy it; I have had plenty of proofs to that effect in my practice.

The fact is, that most of these muscles are worthless before and after their division, because most patients content themselves with a straight and useful extremity, though the mobility of the interested joint may have been partially or totally lost.

The inefficiency of gradual extension has led to the adoption of a more efficacious and practicable method for the treatment of fibrous anchylosis, known as forcible extension or *brisement forcé*.

Some twenty years ago, Amussat called the attention of the Royal Academy of Medicine to the method of M. Louvrier, and caused a committee to be appointed to investigate its startling results. The report thus elicited from competent surgical judges, presented that up to that time Louvrier had treated twenty-three cases of contractions of the knee-joint; that he employed a rather clumsy and complicated apparatus, by means of which he forcibly broke down all resistance and straightened the respective limbs; that the results were but imperfect; that no good form was obtained; that a few had been straightened perfectly and remained so; that, in some, posterior subluxation of the tibia had been produced, and that three patients had died from operative shock, purulent infiltration, and pyæmia. Louvrier himself admitted, with laudable candor, the shortcomings of his method.

In spite of the enthusiasm on the part of the younger members of the profession for the new method, it met with but a cold reception among the contemporaneous surgeons of note. But a low therapeutical estimate was put upon it; and at best it was pronounced a cruel measure, worse than the trouble it was designed to relieve. Fergusson and Stromeyer were its most determined opponents, and disposed of it in not very flattering terms.

If I do not mistake, Dieffenbach was the only surgeon of distinction who not only vindicated *brisement forcé*, but had the courage to adopt it against all clamor. He however modified the proceeding, by substituting the hand for the surgical rack of Louvrier, and included tenotomy and myotomy as preparatory measures.

In a comparatively short time this distinguished surgeon had operated upon two hundred patients, and reports the general result in his work on operative surgery, to the effect that he lost but two patients from suppuration and pyæmia; amputation was required in one; in some the limb was improved to a moderate degree, in others anchylosis became reëstablished. A large proportion of the patients were materially benefited.

Some advancement has this method of treatment received at the hands of Professor Bernhard Langenbeck, of Berlin; but it

should be remembered that he had a most powerful aid in chloroform. In his inaugural dissertation on entering upon his professorship,* he pronounces gradual extension ineffective. The division of the contracted muscles, as performed by Dieffenbach, is superfluous, and even dangerous, by inviting the entrance of air, and thus giving rise to suppuration. Louvrier's method is, according to him, too uncertain, and its results removed from the control of the surgeon. The technicism of Langenbeck conforms in most points with those of Dieffenbach. The results which Langenbeck attained, up to 1853, are compiled in the inaugural dissertation of Philipp Frank.†

In carefully analyzing the results of Louvrier, Dieffenbach, and Langenbeck, and in comparing them with each other, it cannot be denied that Dieffenbach's were superior to Louvrier's, and Langenbeck's better than his predecessors'. But all of them are certainly imperfect, and by no means satisfactory. Louvrier caused in three cases considerable injuries to the knee-joint, and consequently lost them. Of what nature these injuries were I have not learned, nor the reason why they happened in three cases and not in the remainder. Very likely that they were cases of true anchylosis, and that he fractured the bones, or caused diastasis of the epiphysis, or tore vessels or nerves. The subluxation of the tibia, in almost all the cases of Louvrier, must have been a great detriment to the final result of his treatment. For, in the first place, the posterior projection of the tibia must have, by necessity, compressed the popliteal nerves and vessels, thus materially interfering with the circulation and innervation of the leg. Again, the gastrocnemius was evidently put on the stretch, and the heel prevented from reaching the ground. Moreover, the contracted flexor muscles were so much irritated as to cause serious subsequent troubles. Dieffenbach's method was therefore a material improvement. In using *manual* force alone, he protected himself against the error of meddling with cases of true anchylosis, not amenable to *brisement forcé*, and by dividing the contracted muscles he relieved the patient from the serious consequences appertaining to undue extension.

* Commentatio de contractura et anchylosi genu nova methodus violentiæ extensionis ope curandia. Berolini, 1850.

† De contractura et anchylosi articulationis genu et coxæ. Berolini, 1852.

Lastly, in breaking the anchylosis up, by alternate flexion and extension, he obviated subluxations of the tibia. The real merits of Louvrier or Dieffenbach for the advancement of this province of orthopædic surgery are, in my humble judgment, obviously greater than those of Langenbeck. The method of the latter is essentially that of Dieffenbach deprived of the benefit of tenotomy, but favored by chloroform.

I have the most unreserved appreciation of the great talents and diligence of Langenbeck, but I appreciate truth and clinical facts still higher. About 600 cases of affection, contraction, and anchylosis of the knee-joint have given me ample opportunity for most thorough clinical observations, and entitle me to a participation in the settlement of the important question which is still being discussed by the highest scientific tribunals of Europe, before which Langenbeck maintains his former position.

On the feasibility of *brisement forcé* we all agree. Its superiority over progressive extension can no more be questioned, and its former opponents have been effectually silenced by the overwhelming results of that practice. It has also been clearly demonstrated that the hand is a better mechanical adjuster than the lever and the screw. But for the introduction of anæsthetics, more especially of chloroform, the operation would have been of little practical value. The pain attending it is severe enough to terrify the boldest patient and surgeon. The subsequent sufferings it entails, and the uncertainty of its success, would have driven it again into oblivion. Chloroform and tenotomy assure the future of *brisement forcé.* The former renders it perfectly painless; the latter protects against consecutive effects, which are worse than anchylosis and the contraction of the knee-joint together. I do not dispute that in some instances simple extension will suffice to overcome, permanently, a moderate reflex contraction. Further, I have observed that a weight of a few pounds fastened to the extremity for a few days will have the same effect. But a high degree of muscular contraction can be subdued by division alone. The name of Langenbeck was sufficient inducement to follow his directions.

I have tried his method in quite a number of cases, and succeeded in most of them in extending the extremity; but as soon as the anæsthesia subsided, the muscles commenced contracting

again, or, if prevented therefrom by mechanical restraint, an intense suffering ensued. There are but few maladies that cause so intense agony, and prostrate the constitution in so short a time, as the persistent extension of contracted muscles. I remember, among several cases, particularly one of a little boy who was brought on from Montgomery, Alabama, with a contraction of the knee-joint. The original disease, synovitis, had subsided two years before. The joint was quite well, and there was no pain felt, either on motion or pressure. Moreover, the mobility of the joint was not materially disturbed beyond the impediment of the contracted flexors. Under chloroform only the biceps muscle felt tense, and I divided it. I then easily succeeded in extending the leg, and in securing its position in a straight splint. The anæsthesia had scarcely passed off when the patient began crying loudly, and very soon the articulation became tender and distended. Inflammatory fever set in, with a pulse of 150. The strongest opiates, the most active and persistent general and local antiphlogistics, made no impression whatsoever. The paroxysmal pains suggested to my mind their specific character. On relieving the limb from its restraint, it immediately bent. This was another indication in the same direction, and yet the tension of the remaining undivided flexor muscles was so trifling as scarcely to deserve notice. On the sixth day after the operation, the joint was greatly distended and fluctuating, without the slightest sign of amendment. At that juncture I again placed the patient under chloroform, when again all muscular tension vanished, and I had to wait for the subsidence of anæsthesia in order to mark the tendons to be divided. What sedatives and the whole antiphlogistic apparatus failed to effect, *tenotomy* did. Rest immediately ensued therefrom. From that moment improvement commenced, and eventuated in perfect recovery. I could adduce several instances of the same striking and conclusive nature. But one will suffice to illustrate the importance of tenotomy in the treatment of the deformity under consideration. I shall now proceed to delineate the plan which I have adopted, and which I have reason to believe is the mildest, the safest, and certainly the most effective. First, be certain in the diagnosis. Fibrous anchylosis may be easily recognized, for there always remains a moderate degree of

mobility at the joint; even osteophytes are not incompatible with mobility, more especially when they arise from one bone, and do not firmly connect with the other. But if both bones are united by osteophytes, there is nothing left of mobility, and in as far as the latter is concerned, there is no symptomatic difference between a true anchylosis and that caused by osteophytes. The previous history of the case alone can give you a clue as to the nature of the anchylosis. From the preceding remarks you may be led to expect osteophytes from previous periostitis, and true bony union from a more structural affection of the joint itself. Supposing, then, that we had either a fibrous or an osteophytic anchylosis, with marked contractions of the flexor muscles, I would suggest, first of all, to divide all the contracted muscles. It will be better to do this six or eight days previous to the performance of the *brisement forcé*. By that time the wounds have firmly closed. No air can enter and give rise to suppuration, and you obviate at least one of the objections raised by the opponents of tenotomy. It is, of course, indifferent whether you use chloroform on that occasion, since but little pain accrues from the operation. Nor do I deem it necessary to give you special advice as to the flexor muscles of the leg, since by extension you can raise them from the adjacent parts, and divide them successively as they present themselves. The division of the tendon of the biceps deserves special mention. The external popliteal or peroneal nerve is in such close approximation to the internal margin of the tendon as to be easily cut through. If this be the case, paralysis of the abductor muscles of the foot and talipes varus would inevitably follow. In order to avoid this nerve, you have to divide the tendon either from outside by dead pressure, with a tenotome not too sharp, or by inserting it close to the inner margin of the tendon, and give the edge an outward direction. With all precaution imaginable, I have nevertheless met with this accident in four cases. Yet I am happy to say that the paralysis arising from the inadvertent division of the nervous peroneus did not exceed six months, the nerve having probably re-united, and thus reëstablished its full innervation.

About eighteen months ago I took charge of a young man who had sustained a serious accident; his right knee-joint having been opened at its outer aspect by a large lacerated wound. The

tendon of the biceps, as well as the peroneus nerve, were demolished for about an inch. The patient has never recovered the action of that nerve, and wears inevitably an instrument (Fig. 68), with an Indian-rubber strap attached in the front, to assist in flexing his foot.

Fig. 68.

But even if there be no trace of mobility in the joint, as in complete osteophytes, tenotomy should precede *brisement forcé*, for reasons requiring no further explanation.

In order to perform *brisement forcé*, the patient should be fully under the influence of chloroform. He should be placed on his face, but at the same time due attention paid to respiration, for at that degree of anæsthesia respiration is very feeble, and in the main diaphragmatic. The slightest impediment may entirely arrest it. As soon as the patient is thus prepared, you have the thigh properly fixed by an assistant, and then, taking hold of the leg, bend it with a sudden jerk, and then extend it; and so continue to alternate between flexion and extension, until the articulation is quite free.

If there be any rotation of the tibia, it will be advisable to amend that position by retwisting it in the opposite direction. This done, bandage the extremity carefully with a roller, surround the knee-joint with strips of stout adhesive plaster, and either fasten the extremity in a straight iron splint, such as I have before shown, or adjust the extension with the pulley and weight, as before described. In order to correct the lateral position of the limb, Professor Robert places side-cushions inside of the splints before fastening the extremity.

By this plan I have obtained most satisfactory results, and have never had any trouble in producing a speedy and steady recovery of numerous patients. It was never followed by inflam-

mation or neuralgia, which other surgeons have complained of; nor did the contraction return, provided all the contracted muscles had been successfully divided. If any of those symptoms should set in, rest assured that the tenotomy is not complete. The earlier you perfect it, the better it is for your patient. It is needless to contend against them by antiphlogistics and sedatives; you will effect nothing. Tenotomy is the only remedy.

Brisement forcé is both in appearance and reality a powerful remedy. It overcomes, by main force, all resistance; it ruptures the fibrous adhesions of the joint and unyielding tissues, and can certainly do great mischief if indiscreetly performed. But in using the necessary precautions with physical power, nothing is to be apprehended therefrom. In the large number of my cases I have had but four accidents: one of them was inevitable, and certainly could not be foreseen. The case refers to a youth of about sixteen years. He was tall, slender, and evidently of feeble constitution. Having been employed in a manufactory, in which he had to tread a wheel, he had thus acquired an inflammation of his knee-joint, which terminated in a deformity. His leg was bent at an angle of 105° (Fig. 69), but permitted mobil-

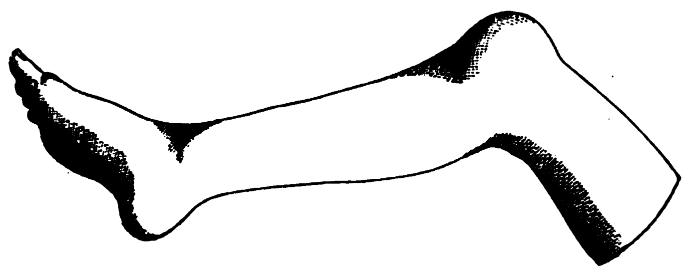

FIG. 69.

ity within an angle of 30°, beyond which there was resistance on the part of the contracted biceps, and other articular impediments. The patella was moderately movable. After having divided the tendon of the biceps, I increased the flexion of the limb by a comparatively gentle effort, when, to my surprise, the resistance suddenly yielded.

A few days afterward a slough appeared in the popliteal space, and the suppuration became so profuse as to render ampu-

tation imperative. It was then found that the epiphysis of the femur had yielded, whereas the articular adhesions had remained unbroken (Fig. 70). The disproportionate strength of the articular adhesion over the union between the lower extremity of the femur to its shaft, was the proximate cause of the accident, and certainly could not have been anticipated. A large proportion of my patients have been children, in whom the same condition of the femur existed; but with the exception of a few cases, I have met with no accident whatever. In reference to the case just related, I candidly confess that I had not the remotest idea that such an accident would happen at the age of the patient, nor did I or any of my able assistants realize its occurrence. It was in fact the worst mishap of this kind, though it has not been the last. The next case happened with a lad from Indiana, aged seventeen years. His appearance was equally delicate, but more from rapid growth than any other cause, for the affection of his knee-joint had subsided some years previously. I performed the operation at the office of my esteemed friend Dr. Gaston, at Indianapolis, and in the presence of the prominent practitioners of that city. They all can bear witness that I proceeded with great care and precaution, and employed no undue violence.

FIG. 70.

Nevertheless, a diastasis of the lower epiphysis of the femur took place; but no serious consequences followed, beyond the delay of treatment, which has since been resumed.

The other two accidents of this description happened with children; one of the cases I have already adverted to.

These accidents are indeed of no great consequence, provided they are promptly recognized and attended to. The limb must be brought back into the former position, and this position must

be secured by bandages impregnated with plaster-of-Paris; in six or eight weeks the union is perfect, and the treatment may then be renewed without further hazard.

It seems to me that these accidents are likely to happen in cases where the intra-articular adhesions are rather tough, and the connections between the epiphysis and shaft of the femur somewhat infirm. The latter may be expected in debilitated and overgrown individuals, and, in such, more than usual precaution is needed to obviate mishaps of this description.

If we consider the small proportion of accidents connected with *brisement forcé*, and the large number of operations I have successfully performed, they scarcely command our notice. But even this insignificant number of accidents may be reduced by still greater precaution; and during the last two years I have successfully avoided them entirely, and hope to do so for the future. Whenever I have reason to suspect infirm epiphysal connections, I do not attempt to break up at once the intra-articular impediments, but do so at three or four different times, and secure each time the gain by appropriate mechanical appliances. The safest way, however, to break up adhesions of this description is by extension, and not by flexion, as I have before advised. The latter is more efficacious, but more dangerous in producing diastasis.

In protracted cases of false anchylosis, we are likewise necessitated to repeat the forcible extension several times before succeeding in giving the extremity the full benefit of a straight position; and we may succeed at a third or fourth repetition when the first attempt proved very inauspicious. This is especially the case when periarticular scar-tissue complicates the mechanical difficulty. In this way an aggravated case of seventeen years' standing was perfectly relieved, and the extremity rendered useful (Fig. 71).

After the *brisement forcé* has been performed, the extremity should be firmly surrounded by a well-applied flannel bandage, with ascending tours from the periphery toward the interested joint, and the latter with tightly applied strips of adhesive plaster spread on Canton flannel, over which the flannel bandage is continued to the body.

The extremity is then placed in a well-adapted and well-padded iron splint; and, thus secured, kept at rest for several

weeks, until the last vestige of soreness of the joint has disappeared.

When the patient is perfectly free from pain or other symptoms, he may be permitted to leave his bed and walk; but even then the limb should be supported by the same instrument which I have recommended for the after-treatment of inflammation of the knee-joint.

FIG. 71.

Most patients content themselves with a straight, useful, and stiff knee-joint. But very few insist upon the reëstablishment of motion. In this case all those measures have to be adopted which I have detailed under the treatment of stiff joints. To realize a full share of mobility under these circumstances is a therapeutic object of considerable difficulty, and should not be entertained without due deliberation. The number of cases in which I have succeeded in reëstablishing motion is very small, and in two only perfect. If we consider that in most of these cases the articular cartilages and the synovial lining are destroyed, and that the intra-articular fibrous tissue passes from bone to bone and from wall to wall, we should not be surprised when success attends but rarely these efforts. Moreover, the intra-articular fibrous tissue again rapidly unites with the same articular surface from which it has been torn, and this is an additional difficulty in the reëstablishment of free motion.

When osteophytes unite the bones between which the joint is formed, there is of course no mobility, and the firmness of the joint simulates that of true bony union, although the previous history of the case may suggest the character of the abnorm

connection. The *brisement forcé* is, after all, the only safe diagnostic test. Fortunately, the osteophytes are not true bony structure, and possess neither its elasticity nor its firmness. These bony splints are rather fragile, and break readily with a crackling sound, as if true bone was giving way.

The presence of osteophytes does not in any way interfere with the *brisement forcé* and its ulterior results, the after-treatment, nor is it materially affected by them.

In extensive and complete osseous union of the knee-joint, *brisement forcé* is of course ineffective. Rhea Barton's operation alone is calculated to meet the emergency. Although originally proposed for the relief of anchylosis of the hip-joint, its author conceived the practicability of the operation in the same morbid condition of the knee-joint. In 1835 he for the first time performed the exsection of a wedge-formed piece of bone from the knee, and the result attained was highly satisfactory. The wound closed in two months, and in five and a half months the patient resumed his avocation as a practising physician.

The second operation of this kind was resorted to by Prof. Gibson, of Philadelphia, and likewise terminated favorably; the patient being capable of walking, without crutches, five months after.

The third operation, Dr. Gurdon Buck successfully performed at the New York City Hospital, in 1844. The patient subsequently sustained a fall from a ladder and fractured the new union; recovery ensued without any untoward accident.

Since then, the same operation has been repeated by Mütter, Bruns (Tubingen), Heuser, B. Langenbeck, Reid, Robert, Post (New York), and others. As far as I have ascertained, but two cases proved fatal (Bruns and Post); the balance recovered with useful extremities. The technicalities of Barton's procedure may be found in every work on operative surgery.

The late Prof. Brainard, of Rush College, has some years ago suggested weakening the interarticular substance by drilling it in various directions through a small wound, and then to fracture the rest. How many operations have been made according to this plan I do not know; but its application signally failed in ·se of one of our most accomplished surgeons (Prof. Gross),

and a chisel had to be resorted to, which was driven through the bony connection.

A similar proceeding had been proposed by Prof. Shuh, of Vienna, as early as 1853, but did not meet with the approval of German surgeons.

Whether the recently introduced so-called osteoplastic operation of B. Langenbeck has been attempted in true anchylosis of the knee-joint, I am equally ignorant; but apprehend that a simple separation of the articular faces by drill or saw will scarcely suffice to give a good form to the extremity, the new bony substance being an impediment; and therefore I would prefer, of all the methods suggested, that of Rhea Barton, which has proved itself both effective and comparatively harmless.

The indications for, and the technical execution of, *brisement forcé* are in most other joints the same as at the knee-joint. But in reference to the hip-joint the operation is subject to some modification, with which I shall now occupy your attention.

Before entering upon the practical consideration of the subject, a short recapitulation of the anatomical condition of the joint left by hip disease will not be out of place. Like the knee-joint, this articulation presents the three forms of anchylosis. Of these, the true or bony anchylosis is certainly of very rare occurrence, judging from the few specimens of this character which can be found in the most complete collections of morbid anatomy. I do not think that I have seen more than two cases during a practice of nearly thirty years' duration. Osteophytes are often met with in the neighborhood of the hip-joint recovered from morbus coxarius. Fibrous anchylosis is unquestionably the most common result of that disease, and we find it generally complicated with malposition of the thigh, arising from muscular contractions.

I have had repeated opportunities of thoroughly examining the anatomical status of joints thus changed. In the first place, I have found the acetabulum enlarged in a posterior and superior direction giving it almost the shape of a figure eight, the new accession being the smaller part. The cartilaginous covering of the acetabulum proper had almost entirely vanished, and upon the accessory portion none whatever could be detected. In some instances the femur was riding on the remnant of the acetabular

margin separating the two articular segments, and for this purpose had a corresponding groove which gave it an accurate fit.

Of the femur, the head had been entirely lost in every single instance, and the neck more or less shortened.

The intra-articular fibrous adhesions fastened the end of the femur to the articular surface of the pelvis, permitting a slight degree of mobility. The capsular ligament was more or less comprised and identified with the intra-articular fibrous structure, and could only in one case, and to a slight extent, be separated therefrom.

In two instances fibrous bands, obviously of a neoplastic character, strengthened the connection of the femur with the pelvis. The osteophytes arose from the neighborhood of the acetabulum, were short and thick, forming no organic connection with the femur, and would have offered no impediment to the *brisement forcé*.

From this short sketch we may arrive at an approximate estimate of the prevailing anatomico-pathological conditions which *brisement forcé* has to contend with.

Buehring was the first who extended the usefulness of *brisement forcé* to the hip-joint, and made strenuous efforts to correct the coexisting deformities. The means employed by him were, however, so defective that but imperfect results were attained. He already adverts to several cases of failure and disaster; in one he reproduced the original disease, to which the little patient eventually fell a victim. And I have to place an instance on record in which, by a fall, *brisement forcé* was effected and subsequently followed by the return of the disease, terminating fatally. The case happened with a lad of Swedish extraction, about sixteen years of age. The original disease had taken its course through several years, terminating in fibrous anchylosis of the joint and malposition of the femur, when the patient was about ten years old. Aside from the existing impediment to locomotion he had not been troubled for six years, when he fell down stairs and thus forcibly broke the existing adhesions. Violent suppuration followed the accident, and destroyed life by pyæmia. Having secured the specimen (Fig. 72), I had the rare opportunity of satisfying my curiosity in a pathological point of view. It is astonishing to me how little destruction has been effected by the late suppuration. All the adhesions have been

of course carried off, and the bony surfaces in contact with each other are osteoporotic, which is probably the normal condition in connection with the formation of fibrous adhesions. The caput femoris is of course destroyed by the original disease; but the neck has suffered no changes by suppuration, since its articulating surface accurately fits in the socket.

I have mentioned these two cases for the purpose of showing that *brisement forcé* of the anchylosed hip-joint is a proceeding not altogether devoid of danger. Nevertheless it is a legitimate operation if performed with due precaution, but the most bril-

FIG. 72.

liant results cannot compare with those attainable at the knee and elbow joints.

The previous division of the contracted muscles is to be insisted upon. Myotomy is not only harmless, and indispensable to a satisfactory result, it lends also protection against the recurrence of the previous morbus coxarius; and I feel persuaded that Buehring would have had better chances to save his patient had he not omitted that initiatory operation. A few days after the operation, we may then proceed to loosen the joint. The patient is to be placed upon the table in the recumbent posture, and, when under the full influence of chloroform, his pelvis is held by an assistant grasping both sides with the thumbs upon the anterior superior spinous process of the ilium, whilst the operator presses firmly his foot against the corresponding t
ischii. Thus prepared, he takes hold of the affected e

and with a firm, steady, but gentle traction, extends and abducts the limb. Gentle motions and rotations may be combined with the traction, but they should never be made so powerful or free as to destroy the existing adhesions. We ought to be contented with a good position of the extremity, and not to risk the lives of our patients for the sake of more or less free motion.

In adults there is less danger of recurring disease, and their limbs bear a freer handling.

The fixing of the pelvis is obviously very important to the ulterior results, and the hands of an assistant fail particularly then to fix the pelvis when the thigh is considerably flexed upon the former; for this, and the purposes of after-treatment, a special apparatus is needed.

Buehring, and subsequently B. Langenbeck, have constructed such apparatus, but they are costly, complicated, cumbersome, and inefficient. After various changes and improvements, I have succeeded in constructing an apparatus which meets all the requirements, besides being cheap and simple, and may be attached to a plain camp bedstead. The apparatus which I submit to your inspection is much more costly than is necessary (Fig. 73). The essential part of the contrivance is a wooden block accurately adapted to the posterior half of the pelvis, inclusive of the tuber ischii. Any wood carver can make it if you furnish him a plaster-of-Paris cast. This block is simply lined with chamois, and if well adapted, the patient can lie in the same for months, with the same convenience and ease with which a gum-plate with artificial teeth may be worn.

FIG. 73.

When the patient is placed in this block he is fastened down by stout leather straps and buckles, in front and across the pelvis. This block is fixed to a plate of sheet-iron by means of screws from below; and the iron plate, by means of four bolts, to the frame of the bedstead. Thus you have a simple and complete fixture of the pelvis which lies closely upon the mattress (Fig. 74). All that remains is an iron frame at the foot of the bed-stead, and two pulleys to shift upon it.

This apparatus should be in readiness when proceeding with *brisement forcé*, and, if need be, may at once be used in place of the table, and in preference to the manual fixing of the pelvis.

If you should not succeed in completely extending and abducting the extremity, you may defer the completion and in the mean time keep the limb in the same position in which your first attempt left it by pulley and weight; or, if you have completely succeeded, the after-treatment may at once be fairly commenced. In these cases extension comes in for its profitable employment. Without myotomy and *brisement forcé* it is more than worthless, because dangerous; in combination with those preliminaries it is a most useful auxiliary. Extension with the aid of my apparatus is certainly most efficient and powerful, since the pelvis is completely fixed, and the patient totally prevented from assuming an accommodating position.

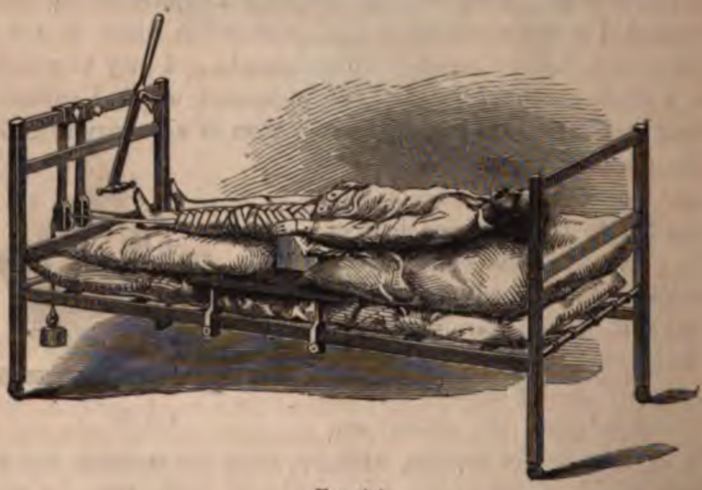

FIG. 74.

I have used it with great benefit in a large number of cases, and know no better substitute.

Two or three months will suffice to render the newly acquired position stable; then you may allow locomotion with the assistance of my portative hip apparatus, with or without crutches, as required.

The true bony anchylosis of the hip-joint finds its relief in

Rhea Barton's operation. I have never had occasion to perform it, and can therefore offer no suggestions drawn from personal experience; but it would seem to me that the attempt at establishing an artificial joint at the line of division is unwarrantable for two reasons: 1st. An artificial joint could never give a sufficient support to the superstructure of the body. 2d. It inevitably protracts the suppuration, with its impending danger of pyæmia.

Sayre a few years ago performed this operation, as he alleged, with success; but his patient nevertheless died a few months after from pyæmia.

The specimen derived from the case did not sustain the assertion of that gentleman; no cartilaginous covering, synovial lining, or a new capsular ligament having been formed.

Now, gentlemen, I have arrived at the end of our discourse, and will finish with relating a few interesting cases. Some of them present peculiar and exceptional clinical features, others may serve as types of their class. Your attention has been most gratifying to me, and I feel sincerely thankful for your magnanimous indulgence.

Case of hygroma bursale traumaticum of eight years' standing.—Fibrous anchylosis of left knee-joint, with flexed and inverted malposition. (Fig. 75 and Fig. 76.)

A young man (Packner) twenty-two years old solicited my professional services in the following case: When at the age of eleven years he sustained an injury of the left knee, which gave him trouble for three years; not materially impeding, however, his locomotion. His general health having materially suffered, his father, a sea-captain, was advised to take the patient on a voyage and give him the benefit of sea-air. On shipboard he repeatedly met with falls and slight accidents without being aggravated. One day whilst driving a nail into a plank, the hammer struck him heavily just above the left knee-joint and caused a painful bruise, soon followed by intense agony and swelling.

From that time to the period when I took charge of his case the patient had never been free from pain and uneasiness; and his haggard, anxious, and desponding appearance bore the unmistakable

evidence of severe and continuous suffering. The affected articulation was so tender as to be utterly useless for locomotion; in fact, he would not even stand upon the extremity with a mere fraction of bodily weight put upon it. Hence crutches were requisite, between which the extremity was suspended.

Fig. 75.

Fig. 76.

The wealthy father had of course successively consulted the best surgeons he could find, both in Europe and on this continent. They had all agreed in their counsel that amputation was the only remedy.

On examining the affected extremity, the following clinical points were elicited:

1. An oval-shaped, smooth, and throughout hard tumor, 9 × 4 inches, located immediately above the knee-joint. Its base was broad, abrupt, and immovable. There was no tenderness or discoloration about the tumor.

2. The joint was anchylosed, but allowed a trifle of motion, which was, however, very painful at its inner circumference.

3. The quadriceps muscle was displaced to the outside of

the tumor; the patella lodged upon and adhered to the external condyle of the femur.

4. The tibia occupied an angle of 150° with the femur, and was so turned on its axis as to evert the toes.

5. Besides, there was a slight inflection at the knee between the two bones, which gave it a knock-kneed appearance.

6. The biceps muscle was considerably shortened, and therefore very tense.

7. The temperature of the knee-joint, more particularly at its inner aspect, was not much raised.

8. In fine, the affected extremity was moderately attenuated.

The tumor was obviously accountable for the existing articular trouble and malposition. It had raised up and gradually displaced the extensor muscles of the leg. The latter derived additional physical power from acting, as it were, around a pulley, being converted into a flexor, rotator, and adductor muscle of the knee. The tibia had yielded to the abnormal traction. The torsion of the joint had set up inflammation of the synovial lining, eventuating in fibrous interarticular adhesion of the articular faces. Reflex contraction of the biceps muscle had ensued. Thus, by the succession of mechanical effects, a most complicated morbid condition had been brought about in course of time, traceable to no other cause than the tumor. The still existing inflammatory action at the inner circumference of the knee-joint may be ascribed to the abnormal position of the extremity, being diagonal through the femur, and bearing the weight of the body upon the internal ligaments.

But the all-important diagnostic question centred itself upon the nature of the tumor! The apparently very hard texture suggested bony structure. For ostoid, the tumor was too hard and smooth, and had existed far too long a time to sustain the suspicion of a malignant growth. Periostitis would have circumvented the femur, and not exhibit a broad and flat base. Bone abscess would have distended the femoral tube in all directions, and at that size would have become softened. The hardness and smoothness of its surface precluded the idea of an osteosarcoma.

The evidently traumatic cause, the gradual increase, the regular form of the tumor, and the anatomical region, pointed directly

and conjointly to the distention of the subcruræan bursa. Yet there was no fluctuation, and that ominous hardness was left unaccounted for. Notwithstanding the discrepancy, I commenced most carefully to explore my ground, with the hope of detecting fluctuation; for the rather indefinite supposition suggested itself, that *the resistance of the vagina femoris* might both render the tumor hard and obscure its fluctuation.

At the inner and lower aspect of the growth, a branch of the saphena magna perforated the aponeurosis and dipped into the depth. There I felt some elasticity and very indistinct fluctuation; sufficient evidence of fluid, at any rate, to warrant explorative puncture. The patient, a very intelligent young man, having realized the probable character of his case, and deriving new hope from the proposed proceeding, readily consented to the exploration.

After having made the necessary preparation, I proceeded next day, with some professional friends, to the patient's dwelling. I met with but little encouragement for the operation, either on the part of colleagues or the relatives of the patient. The former dissented *in toto* from the suggestive diagnosis, and the latter presented the authority of the best surgeons of the country as objection to any other proceeding short of amputation of the thigh.

The trocar being inserted, about ℥ xiv. of a straw-colored and alkaline flüid was withdrawn, whereupon the tumor collapsed. On careful examination, the empty sac and its contours could still be discerned; but, of course, the previous hardness had entirely vanished.

Having thus verified the diagnosis, I proceeded with the second part of the programme, *in dividing the outer hamstring, breaking up all articular adhesions, and in fully extending* the extremity. A few minutes served to change the condition of the patient, and infuse him and his friends with new hopes for the future. It could hardly be anticipated that pressure alone would suffice to prevent the reaccumulation of the bursal fluid. In order to close up the old depot, I was induced to inject tincture of iodine.

That operation was followed with violent inflammation and suppuration of the bursa. When, at last, the cavity had closed, the quadriceps muscle was so firmly agglutinated to the thighbone that it seemed indifferent whether the articulation of the

knee-joint was reëstablished or not. The patient, desirous for active life, declared himself quite contented with a straight, useful, and painless though inflexible extremity, with which he is now able, according to a recent letter to a friend, to walk his forty miles a day, by peddling in California.

The presented photograph (Fig. 76) is the appearance of the patient at his discharge. At that time I supported his extremity with a straight apparatus, with which the patient now dispenses.

That the hardness of the tumor was simply caused by the constraint and resistance of the vagina femoris, will be admitted without further dispute. And we noticed the *same symptom* in the case of Mr. A., one of the great hotel proprietors of New York. We need hardly say that the correct treatment of Mr. A.'s case depended likewise on correct discernment of the tumor, about whose character and structure conflicting opinions and apprehensions had been advanced.

Case of morbus coxarius in its third stage.—Consecutive abscess connecting with the joint.—Complete prevention of malposition.

George D——, ten years old, of good constitution and general health, descending from healthy parents, and one of nine children who are enjoying perfect health, came twenty months ago under my treatment. His left hip-joint was then very tender and immovable; the extremity was slightly bent upon the pelvis, abducted and rotated, with eversion of the toes. The pelvis was lowered at the affected side, and the spine consequently inclined the same way. On examination under chloroform, it was found that the hip-joint was almost immovable, allowing but slight flexion and extension, but no adduction and rotation whatsoever. The tensor vaginæ femoris and the pectineus muscle contracted.

There was but a moderate fluctuation at the joint. In addition to this, I was informed that the patient complained of pain at the knee and violent nocturnal paroxysms. The limb was moderately attenuated. Although the boy had manifested the symptoms of morbus coxarius but a very short time, he gave evidence of constitutional suffering, looked pale and thin. A fall directly upon the left hip was assigned as the ostensible cause of this disease.

These symptoms strictly coincided with the second stage of morbus coxarius.

The treatment was initiated with leeches to the affected articulation. The contracted muscles were thereupon divided, and the patient was placed in the wire apparatus, and thus rest and position of the extremity insured.

The immediate effect of this treatment manifested itself in complete repose and immunity from pain, both structural and reflected. This treatment was continued for six months, when again a thorough examination was instituted. There was almost complete mobility, without crepitus; no fluctuation about the joint; the limb occupies a rectangular position to the pelvis. There was no pain on pressure or motion. The constitutional appearance of the patient was notably improved; appetite and rest were perfect. Presuming that the disease had been effectually arrested, I allowed the patient one hour's locomotion per day, with the hip-splint and crutches; and this time to be gradually prolonged, provided no active symptoms should recur: during the balance of the day and the night in the recumbent posture, and the limb again secured as before. There was no reason to alter the plan, and at the end of another six months he enjoyed his full freedom and went regularly to school; crutches and portative apparatus, as well as the wire apparatus during the night, being continued.

About four months ago an abscess formed over the place where the tensor vaginæ femoris had been divided, and was attended with the ordinary signs. It was punctured, evacuated, and its walls kept compressed by flannel bandage; since then it has three times refilled, and again been punctured. Each time the wound closed. The matter drawn from the abscess was rather thin and somewhat soapy, containing however no structural detritus of any account, and particularly no elements of bone.

I am rather undecided as to the nature and meaning of the abscess, and have no means of ascertaining whether it connects with the joint or is the consequence of suppurative bursitis. There is indeed not a single symptom indicative of the joint being implicated, although the possibility cannot be denied. But the fact that the punctures close and form no sinuses, is rather against articular suppuration. It is at best, therefore, an open question.

On the other hand, I have seen these abscesses often form at the

same location, and subsequent to the division of the tensor vaginæ femoris. Not unlikely these abscesses grow out of an injury to the bursa of that muscle, and would have no great pathological import. If this version should prove true, the diagnosis of this case should be modified accordingly. From the general aspect of the case, I expect perfect recovery at no distant time. The diagrams (Figs. 77, 78) represent the present status

Fig. 77.

Fig. 78.

of my patient in as far as the position of the affected limb is concerned, and it will be observed that form, position, and length are normal; not even the circumference of the limb differs materially from its fellow.

Case of malposition of the right limb, with more than four inches shortening, the result of now extinct hip disease.

Harry M—, eleven years of age, came under my charge in the

following condition. The right extremity considerably attenuated; the thigh without its proper contours; extreme adduction and inversion; pelvis tilted up and rotated backward; corresponding deflection of the spine; gait very awkward and limping, in spite of a four-inch heeled boot; trochanter major protrudes considerably, and exceeds by three-quarters of an inch a line drawn between the anterior superior spinous process of the ilium and the tuber ischii; insignificant mobility of the articulation, without a trace of abduction and rotation.

These impediments were the consequences of morbus coxarius, since eighteen months entirely extinct.

Although of slender build, he had enjoyed perfect health, and been a very active boy up to the very time when he was suddenly struck down with that disease.

There is no morbid diathesis in the family; the father of the patient is even a very robust, muscular, and active man, the very picture of health and manliness. In addition to this, the patient has been, and is still, surrounded with the attributes of opulence and rational hygiene. The premonitory symptoms were but few, insignificant, and of short duration. When at a boarding-school in the country the patient was suddenly attacked with the most violent symptoms of morbus coxarius, which continued with unabated intensity for five months; then they almost as abruptly abated, leaving the patient in that deformed state which I have briefly sketched. But the shortening had steadily increased, so as to require from time to time a higher heel to his boot. Even during the six months preceding the operation, the increasing shortening of the limb had been observed. He had, however, completely regained his standard of excellent constitutional health, and was as active as before. There were no local symptoms indicative of continued joint disease.

I have not been able to ascertain the cause of the original attack. There is certainly no pretence of constitutional causation, although the patient does not remember having met with any accident worth speaking of. I nevertheless consider myself justified in assuming the same, for the very activity of the patient seems to warrant such a supposition; still more so the violent character of the disease and its rapid course without suppuration.

The patient came under my treatment in the spring of this

year, and remained four months with me. During this time I have divided successively most of the abductor muscles; and at four different occasions, with the assistance of chloroform, broken down most fibrous adhesions, and by steady extension in the recumbent posture and repeated passive motions I have succeeded in placing the affected extremity in a rectangular position to the pelvis, and extended and loosened the still existing fibrous impediments to such a degree as to allow moderate mobility of the articulation.

From the high position and prominence of the larger trochanter, it is evident that the neck of the femur rides upon and is fastened to a new articular facet at the superior and posterior portion of the acetabular margin, where it still remains, and from which position I do not intend to displace it. At the end of the second month I allowed locomotion to the patient, supported by crutches and my first hip apparatus. It was at that time that the photographs (Figs. 79 and 80) were taken. You may judge for yourselves of the material changes towards improvement which had been effected up to this time. Previous to his discharge, another photograph, with the second hip instrument applied, was obtained (Fig. 81). In that position the pelvis has resumed its proper level, the extremity stands rectangularly within five-eighths of an inch off the floor. The passive motions are still continued with due care, and daily lubrications are being made with phosphorated oil, to promote healthful innervation and nutrition.


FIG. 79.

The patient is directed to wear the hip instrument night and day until the changes of form and position become permanent,

when a heel five-eighths of an inch higher than that of the other boot will suffice to ensure easy gait and locomotion.

These changes have been wrought within the short period of four months, in a deformity and malposition which in former

FIG. 80.

FIG. 81.

times were considered beyond surgical aid; and this case furnishes, therefore, an illustration of the grand progress in orthopædic surgery.

BROOKLYN, N. Y., Clinton, corner of Warren Street.

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